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MACHINERY

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SHOP PRACTICE

MACHINE AND TOOL DESIGN

MANAGEMENT PROBLEMS

DEPARTMENTS

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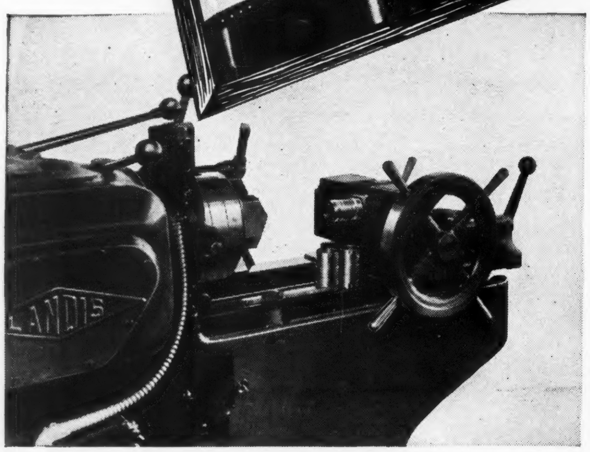

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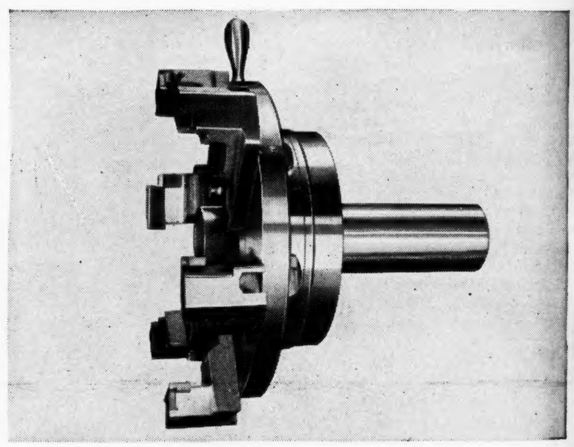

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MACHINERY

Vol. 56 JULY, 1950 No. 11

Economical Short-Run Production of Elevator Parts

By J. J. HOGAN, Manager, Process Division
Otis Elevator Co., Yonkers, N. Y.

ELEVATORS are usually designed specially to suit the installation for which they are intended, and are seldom identical. This complicates the production problems by making it necessary to manufacture comparatively small lots of many different parts. Tooling and machines employed by the Otis Elevator Co. for the economical short-run production of elevator and escalator parts are described in this article.

Profitable small-lot production of parts on automatic screw machines is made possible by the use of machines specifically designed to min-

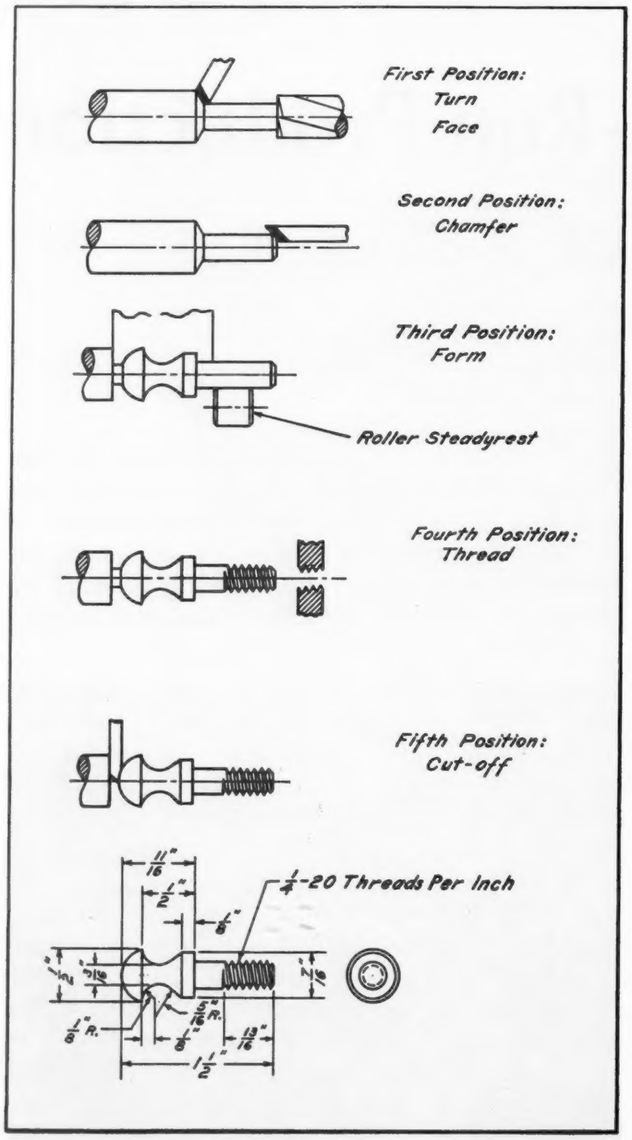


Fig. 1. Successive steps in production of stainless-steel part seen at bottom

imize set-up time. A battery of six Warner & Swasey five-spindle automatics, seen in the heading illustration, and two four-spindle automatic screw machines is employed for short-run requirements of studs, bolts, nuts, and other screw machine products. Only three men are required to set up and operate the eight machines, and the output from these machines exceeds that previously obtained from five hand screw machines, eight four-spindle automatics, one five-spindle automatic, and six single-spindle, old-style screw machines. Annual savings effected by the use of these machines are approximately 20 per cent.

The five-spindle automatics are provided with twelve tooling stations consisting of five independent cross-slides; one pentagonal, longitudinal slide having five positions; and two independently operated, auxiliary, longitudinal slides. Each slide has a stroke infinitely variable between zero and the maximum working length of the slide. The length of the stroke is mechanically controlled by a quadrant linkage arrangement, and can be quickly changed by means of a simple slide adjustment. Twenty-four spindle speeds are provided on the 2 1/4-inch capacity machines, and eighteen rates of feed are available for each speed.

A typical piece produced on these machines is seen at the bottom of Fig. 1. This stainless-steel part is turned, faced, chamfered, formed, threaded, and cut off from 1/2-inch diameter bar stock at the rate of ninety per hour. The five spindles are rotated at 451 R.P.M., giving a surface speed of 59 feet per minute on the maximum diameter. A feed of 0.0033 inch per revolution is provided for the main tool-slide during its 7/8-inch longitudinal stroke.

At the first position, the diameter of the bar is reduced to 1/4 inch and the end is faced by means of a turning tool and a facing cutter, as shown in the illustration, both of which are mounted on the main tool-slide. The outer end of the turned bar is chamfered by a tool mounted in the second position on the main tool-slide. At the third position, the head of the work is formed by a tool mounted on the cross-slide. During the forming operation, a roller steadyrest is employed to support the end of the bar. The forming tool is fed 0.0009 inch per revolution for a stroke of 1/4 inch.

The part is threaded by means of a universal threading attachment mounted on the upper auxiliary longitudinal slide in the fourth position. A positive lead is obtained by adjusting the stroke setting on the quadrant to impart a movement on the threading slide equal to the thread lead. A threading ratio of 5.27 to 1 is employed, with a feed of 0.00474 inch per revolution for a stroke of 1 1/4 inches.

The finished work is severed from the bar in the fifth position by means of a cut-off tool on the cross-slide, which is fed 0.0009 inch per rev-

olution. A completed part is produced every 39.8 seconds.

Formed contours and concentricity of the periphery relative to the bore of the part can generally be maintained within a tolerance of 0.001 inch on these machines without the use of shaving tools. Smooth surface finishes are consistently obtained. Fig. 2 shows a close-up view of the tooling area as seen from the rear of one of the machines. In this set-up, bolts 1 inch in diameter by 7 1/4 inches long over all are produced from hexagonal bar stock at the rate of forty-five per hour.

As many as four hundred different parts are produced on these six automatics in a year. The flexibility of the standard tooling permits many sizes and shapes of work-pieces to be handled without the need for expensive special tooling. By properly scheduling the work to the machines, the tooling changes can be minimized and the set-up time further reduced. Production rates on certain parts have been increased as much as 350 per cent over those possible on hand screw machines or single-spindle automatics.

Shafts for the motors, generators, and other equipment used with elevators are tapped and centered on the special Baush two-way, horizontal drilling and tapping machine seen in Fig. 3. Both ends of the shaft are center-drilled simultaneously, and the average time required for tapping, drilling, and countersinking has been reduced from 13.6 to 5.8 minutes. A tolerance of $\pm$ 0.0015 inch is maintained on the depth of the center holes, and shafts from 9 to 84 inches in length and from 1 to 7 inches in diameter can be handled on this machine.

Two pairs of air-operated, self-centering V-jaws are provided for clamping the shaft. Axial location of the shaft with relation to the drilling and tapping heads is obtained by means of sliding gage-bars mounted on the V-jaw blocks. Plates holding interchangeable bushings for guiding the tools are also mounted on these blocks. Quick-acting, adjustable-collar chucks facilitate changing the tools. Rapid approach, feed, rapid return, and stopping of each head are automatically controlled by limit switches and barrel type cams.

Three sizes of eye-bolt handling holes are produced, the size depending upon the diameter of the shaft. On the larger shafts, a 21/32-inch diameter drill, a 3/4-inch tap with ten threads per inch, and a 1 1/8-inch combination center drill of special design are employed. The combination tool produces a 60-degree by 1 1/8-inch diameter countersunk hole. A 27/64-inch diameter drill, a 1/2-inch tap having thirteen threads per inch, and a 9/16-inch diameter countersinking tool are used on the smaller shafts. The drills and combination tools are fed at the rate of 0.0079 inch per revolution while rotating at 280 R.P.M. A speed of 29 R.P.M. and a feed of 0.077 inch per revolution are employed for tapping.

Previously, such shafts were drilled, tapped, and centered by the use of several lathes. Only one end of the shaft could be machined at a time, and then it had to be swung around and rechucked or transferred to another lathe. Now

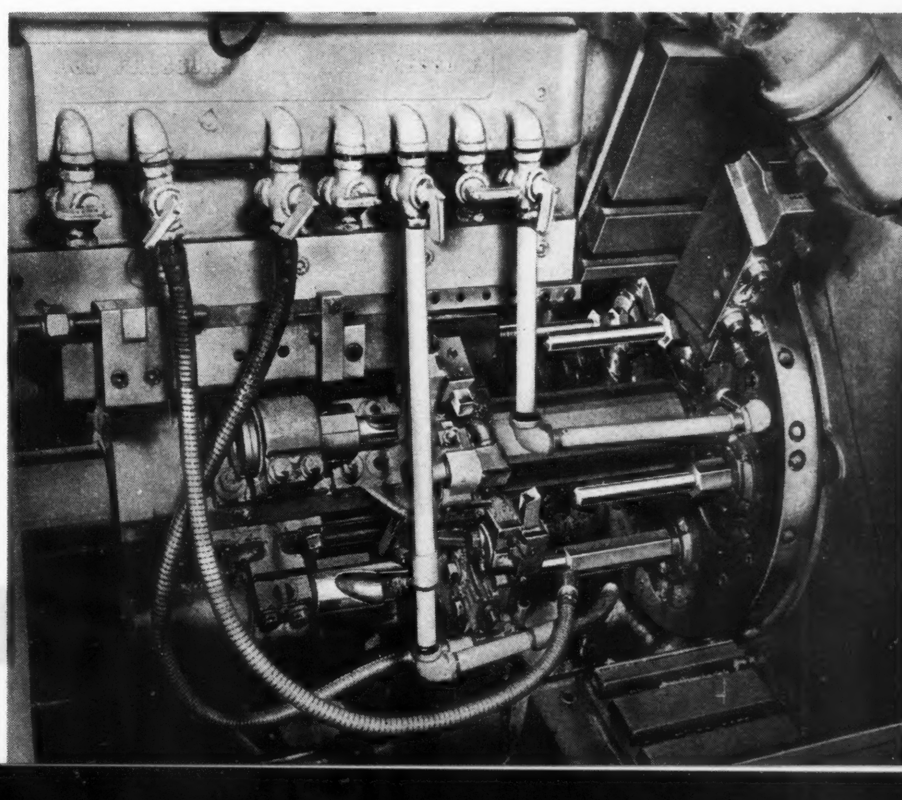


Fig. 2. Close-up view of tooling used on a five-spindle automatic for producing bolts from hexagonal bar stock at the rate of forty-five per hour

Fig. 3. Two-way drilling and tapping machine employed to drill, tap, and then countersink both ends of a shaft simultaneously

a wide range of shaft sizes can be completed on a single machine by a simple operation. Handling of the work has been minimized, closer tolerances can be maintained, and reworking has been practically eliminated. The annual saving effected by the use of this machine is about 15 per cent.

A finish-turned shaft is employed as the templet on the American "Pacemaker" hydraulic shaft-duplicating lathes used to accurately reproduce multiple-diameter shafts at high production rates with a single cutting tool (Fig. 4). Production increases up to 75 per cent have been obtained by the use of these machines, with correspondingly large savings. Three of these lathes have replaced seven old-style engine lathes previously used.

The shaft templet is held between adjustable centers mounted on supports at the rear of the lathe, as seen at the upper right in Fig. 5. A hardened steel stylus with a ball-shaped point is kept in contact with the templet by hydraulic pressure. As the stylus is fed across the templet, it automatically controls the movement of the cutting tool. The tool-slide operates at an angle of 45 degrees with the axis of the work to compensate for longitudinal movement of the carriage when cutting chamfers, rounded corners, or right-angle shoulders. For turning large-diameter flanges, it is only necessary to disengage the longitudinal feed and employ the cross-feed.

Not more than one hydraulically controlled tool cuts at a time. When both rough- and finish-turning are required, both tools can be mounted in the four-way tool-block, and either tool swung into cutting position. It is, of course, necessary

Fig. 4. Multiple-diameter shafts are accurately reproduced at high production rates on a hydraulic shaft-duplicating lathe

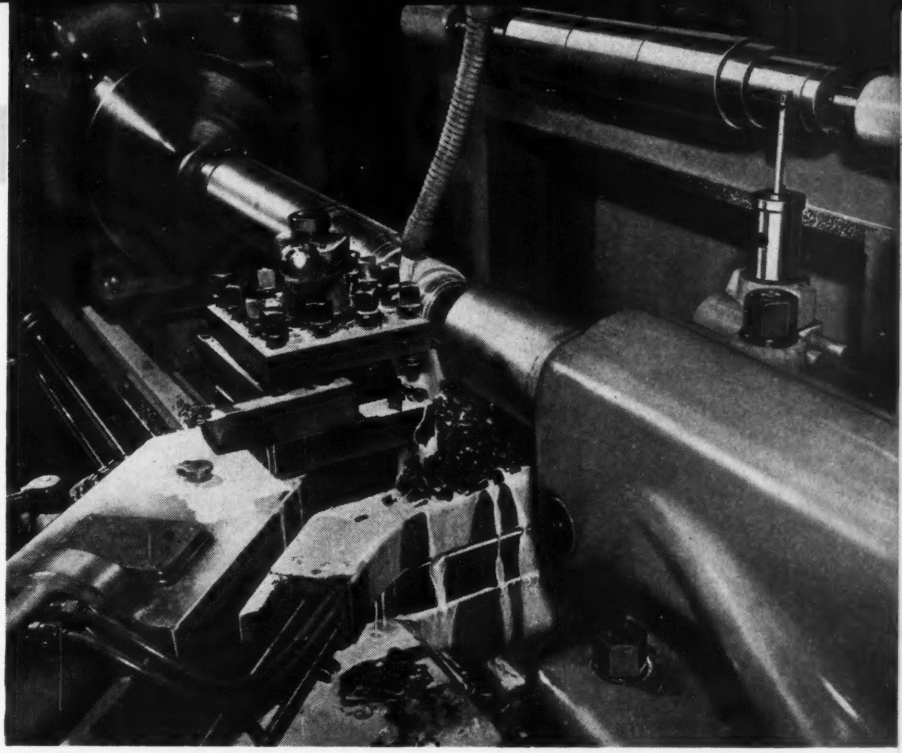


Fig. 5. A finish-turned shaft (upper right) is used as the templet in turning multiple-diameter shafts with a single cutting tool

to reverse the position of the work in the lathe to complete both ends.

Shafts made from S A E 1045 steel (annealed) are rotated at a surface speed of 300 feet per minute for roughing, and at 400 feet per minute for finishing. The carbide-tipped single-point tools are fed at the rate of 0.020 inch per revolution, with a maximum depth of cut of 1/2 inch. Depth of cut can be varied by moving the independent hydraulic tracing-valve slide, thus changing the location of the stylus point with relation to the cutting tool. Very smooth surface finishes are obtained, and a run-out tolerance of $\pm$ 0.0005 inch is maintained on most shaft diameters.

A large armature shaft, forged from S A E 1045 steel, is shown being finish-ground on a Landis hydraulic grinder in Fig. 6. This shaft has a maximum diameter of 24 inches, and is 89 11/16 inches long. The huge machine will accommodate work-pieces 27 inches in diameter by 120 inches long. The periphery of the flange is ground to a mirror-like finish, and is held to size within $\pm$ 0.0005 inch to provide a shrink fit for a driving sheave subsequently assembled to the shaft.

A vitrified-bond, aluminum-oxide abrasive wheel, of 54 grain size, is employed. The wheel is 30 inches in diameter by 4 inches wide, and is rotated at a surface speed of 5500 feet per minute by a 20-H.P. motor. The armature shaft, held between centers, is rotated at 25 R.P.M. by a 2-H.P. motor. Hydraulic rapid in-feed advances the wheel to the grinding position, and it is automatically fed 0.0003 inch per revolution after each carriage reversal. A multiple stop

Fig. 6. Periphery of large flange on this armature shaft is being finish-ground in preparation for shrink-fit assembly of a sheave

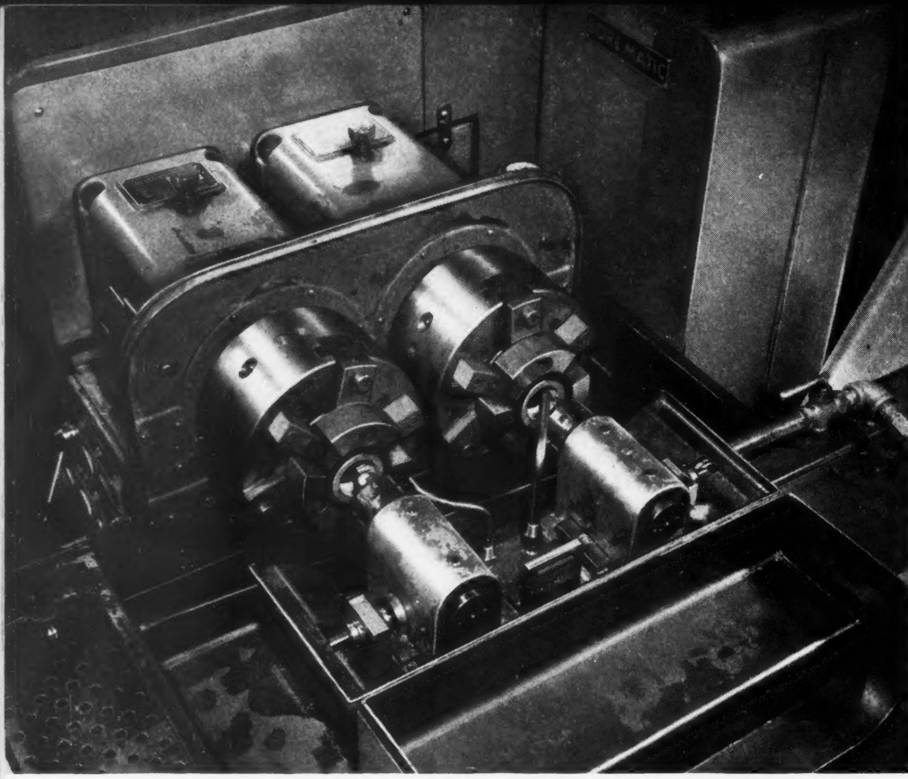


Fig. 7. Bores of rubber-covered steel roller guides are machined to size within plus or minus 0.0003 inch in this set-up

device provides means of consecutively grinding the seven different diameters on this shaft. Reference points on a dial mounted on the hand-feed wheel are pre-set to correspond with diameters to be ground.

Rubber-covered steel roller guides used in Otis escalators are precision-bored by means of the set-up seen in Fig. 7. Since an anti-friction bearing is subsequently pressed into the bore of the roller guide, the bore must be held to size within ± 0.0003 inch. Prior to the acquisition of the Heald Bore-Matic double-head, precision boring machine, it was necessary to grind the bores in order to maintain these close tolerances. Now the need for subsequent grinding has been eliminated and production increased. Annual savings resulting from the use of this machine are about 66 per cent.

Approximately 0.020 inch of stock is removed from the roller-guide bores in two operations, the guides being rough-bored while mounted on the front head, seen at the left, and finish-bored on the rear head. The work is rotated at 500 surface feet per minute, while the single-point, carbide-tipped boring tools are fed at the rate of 0.005 inch per revolution for roughing and 0.003 inch per revolution for finishing. A production of ninety per hour is obtained.

Designing Dies for Powdered-Metal Parts

By EDWIN MOSTHAF
Industrial Consultant

WHILE much information has been published on the subject of designing, sintering, and the general processing of powdered-metal parts, little attention has been given to the design and construction of dies for producing them. As in designing dies for other metal-working operations, the aim must be to design dies that can be made and maintained economically and that can be used for high production, with a minimum of rejections.

A thorough knowledge of the material to be worked is important to the designer of dies for pressed-metal parts. Complete and accurate data must be available to the tool engineer on the following points:

Type of material (bronze, brass, iron, or other powder).

Pressure required (in pounds per square inch).

Die fill ratio (volume of loose powder to volume of pressed part, see Fig. 1).

"Spring-back" of part after pressing (expansion after leaving die).

Sintering shrinkage or growth.

Allowances for sizing, if required, to increase physical properties or to maintain close dimensional tolerances.

Having obtained this information, the tool engineer can proceed with the preparation of a work drawing, as shown in Fig. 2. This shows the part to be made in each of the various stages of the process. The top view shows the "green" or unsintered briquette, the middle view the "fired" or sintered part, and the bottom view the finished part with the manufacturing tolerances.

The dimensions shown on the drawing for the various stages are determined by utilizing some of the information listed above. For example, the finished outside diameter of the flange on this part is to be 0.500 inch, plus 0.000 minus 0.004 inch. The mean dimension, after sintering, is 0.498 inch, as shown in the middle view. If the shrinkage factor is 1.004 and there is an allowance of 0.0002 inch for expansion of the briquetted part after ejection from the die, this dimension in the unsintered state should be 0.5002 inch. The dimensions of the die are based on those of the unsintered part, since these determine the size of part required in the "green" state to obtain the desired final dimensions after sintering. If the physical properties of the part or the tolerances on the finished dimensions were such that a sizing operation were needed after sintering, allowances would have to be made for this too.

These drawings serve as specification sheets for processing the work through the plant, and they are especially useful for inspection purposes. At the presses, for instance, a check of the "green" briquette in comparison with the dimensions of the unsintered part on the specifications drawing shows immediately whether or not tool changes or pressure adjustments are necessary. Moreover, parts that are not in accordance with the drawing at any particular stage can be diverted immediately from further processing. This procedure saves considerable time and eliminates waste, since the physical characteristics of a part after any operation depend to a considerable extent upon those resulting from a previous operation.

A careful analysis should be made of the tol-

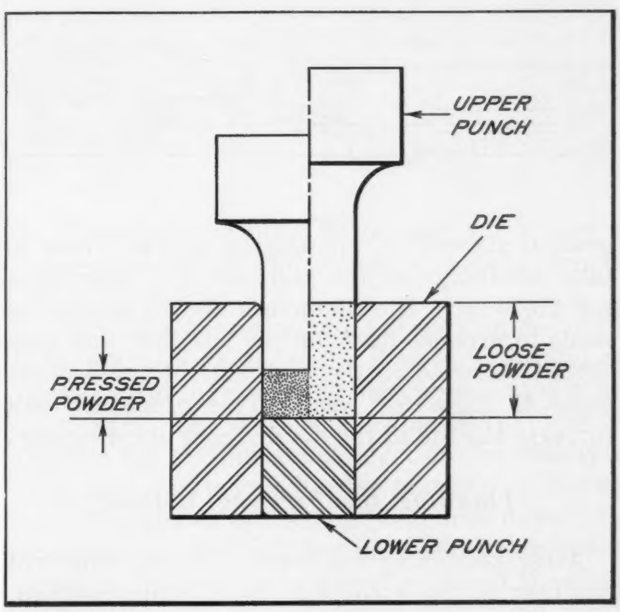


Fig. 1. Cross-sectional diagram of simple die for a powdered-metal part, showing relationship between volume of loose powder required and size of pressed part

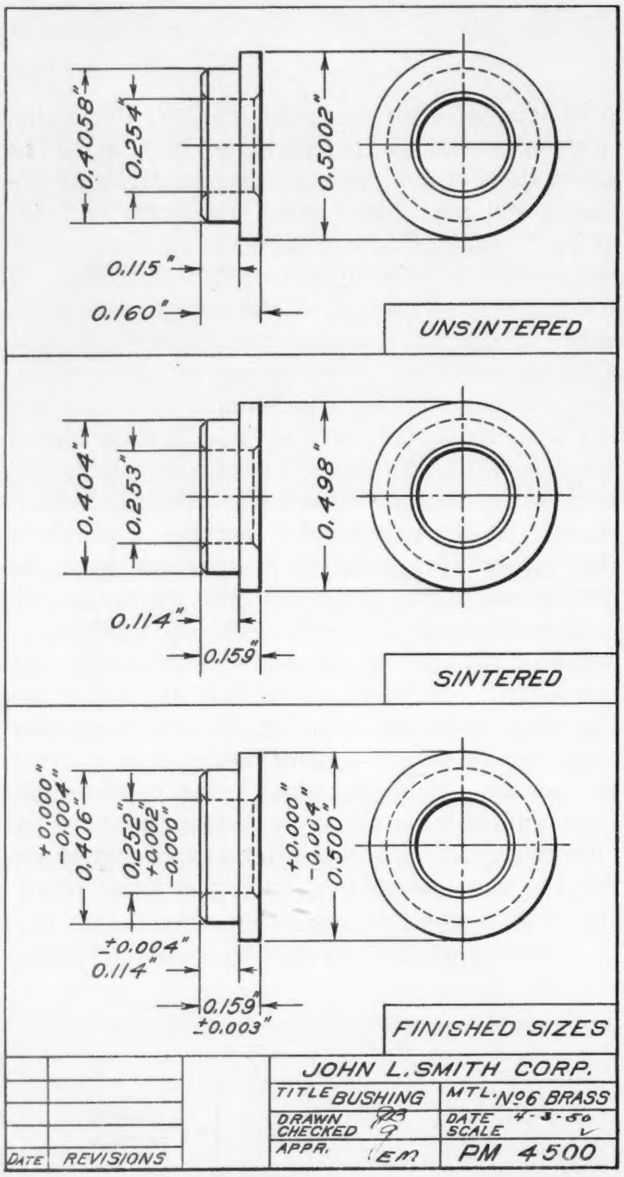


Fig. 2. Typical specification drawing, showing the dimensions of a powdered-metal part in three stages of manufacture

erances allowed on the finished part in order to take advantage of the high and low tolerances for die wear. Die diameters should always be made to produce parts on the low side, and pins should be made on the high side of these tolerances to allow for wear. This procedure will increase the life of the die and pins considerably.

Planning the Pressing Method

After preparing the work drawing, the tool engineer is ready to plan the pressing method. This is the most important phase in the tooling program, and considerable time and thought should be given to it. A good method is to make preliminary rough sketches of the die and punches, keeping in mind the press in which the part is to be made.

This will save time in the preparation of accurate tool lay-outs because several ideas can be quickly sketched before developing the one finally chosen. By considering the different pressing methods in this way, the most efficient one can be easily selected, thereby avoiding costly changes after the tools have been made. This is particularly true in the case of dies that may be made in split sections to facilitate the pressing operation and to reduce tooling costs.

It is advisable to design the die so as to maintain a given die fill ratio over varying sections of a part in order to insure an even distribution of density in the pressed and sintered briquette. This is important because the loose powder will not flow from one part of the cavity to another as freely as plastic or ceramic materials.

An example of a design in which provision was made for filling the die properly may be seen in Fig. 3. The top inner punch, which can move independently of the outer punch, is shown at *A*, the top outer punch at *B*, the die at *C*, the lower inner core sleeve at *D*, the lower punch at *E*, and the stationary core-pin at *F*.

It can be seen that a die fill ratio of approximately 2 to 1 is maintained throughout all sections of the part by raising the inner core sleeve *D* during the filling operation. This prevents the deposit of more powder than is needed over the thin section of the part. In view of the fact that non-uniform density causes uneven shrinkage or growth in sintering, it is apparent that filling the die properly is an extremely important consideration in designing these dies.

Fig. 4 illustrates a similar problem, often encountered in pressing relatively long parts. Here the center section of the part lacks the proper density, compared with the ends. This condition, referred to as "bridging over" of the powder, may pass undetected at the presses unless samples are broken open and inspected. This is due to the fact that it is possible for the samples to

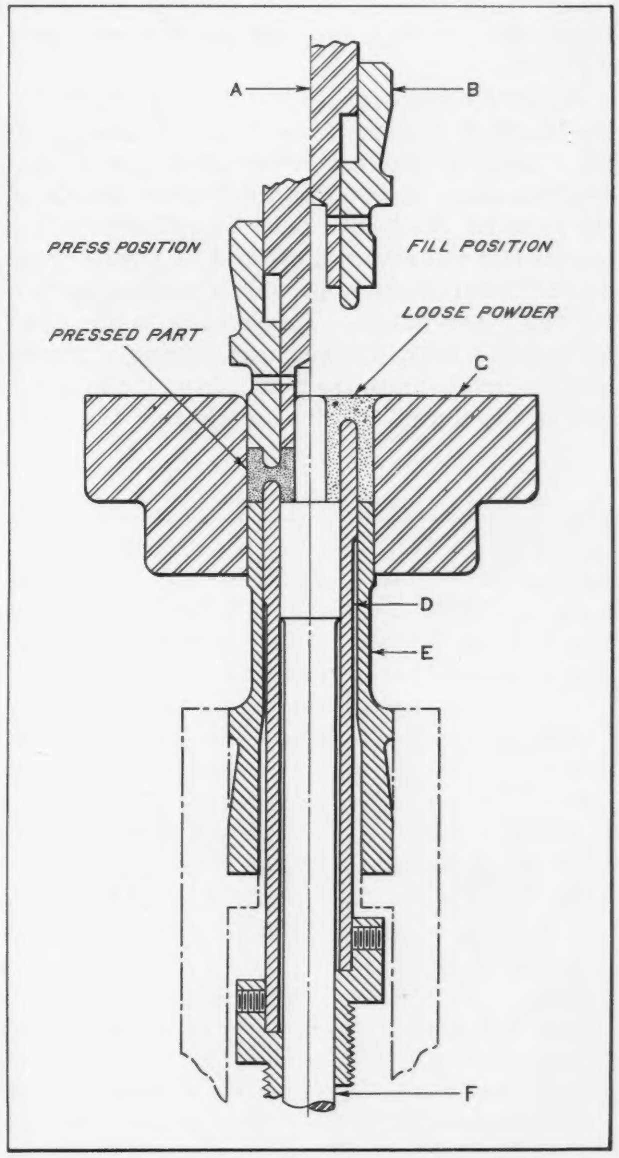


Fig. 3. Cross-section of die designed to provide uniform density in a powdered-metal part having a thin center section

be of the correct weight and yet not have been properly pressed.

Makeshift procedures are sometimes employed at the presses to overcome the problem of uneven density, resulting in excessive pressures, which produce unsatisfactory parts and often damage the tools. It is therefore essential to make use of top and bottom pressure when briquetting relatively long parts, and it is always good practice to design the dies so as to provide for proper distribution of powder where a part of irregular cross-section is to be made.

Selection of the Proper Press

The press selected for a given job depends on the diameter and length of the part to be made, and the pressure necessary to produce the part. Often presses are overloaded, as far as pressure requirements are concerned, and in such cases, the complete set of tools must be adapted for a press of greater capacity. The time spent in the tool-room making punch and die adapters to fit the larger press delays the job and adds to the costs.

In selecting the press, first determine the projected cross-sectional area of the part, and then multiply this figure by the pressure, in pounds per square inch, required to obtain the proper density. This will be the total pressure required. From this figure a press of the proper capacity can be selected.

For example, find the total pressure necessary to briquette a 3-inch diameter bushing with a 1-inch diameter hole through the center, using a briquetting pressure of 40,000 pounds per square inch. Subtracting the area of the hole from the area of the 3-inch diameter bushing to get the actual projected area, we have:

Area of 3-inch diameter section.....7.068 sq. in.
Area of 1-inch diameter hole.......0.785 sq. in.

Actual projected area ....6.283 sq. in.

Then, multiplying the actual projected area by the pressure in pounds per square inch, we get the total pressure required:

$$6.283 \times 40{,}000 = 251{,}320 \text{ pounds}$$
(or 125.66 tons)

Therefore the press to be used for a part of these dimensions should have a capacity greater than 125 1/2 tons.

This data may also be used as a guide by the tool engineer in designing dies to withstand repeated loads at relatively high pressures without springing. A very small amount of vertical spring has an immediate effect on the density of the part, and may cause the material to "bridge over" as shown in Fig. 4. Many dies have failed because the designer has not made them sturdy enough, in order to save on the cost of the material, although the amount of steel used repre-

sents a very small portion of the total tool cost. In all cases, strong dies and punches pay good dividends.

Another consideration in selecting a press is the length of the part to be made. Inasmuch as the volume of loose powder required may be two or three times as great as the pressed length of the part, the die length must be sufficient to accommodate the required amount of powder plus an additional length to provide a bearing surface for the lower punch. This results in the need for a press with a lower ram having a stroke long enough to move the punch from the fill position to the top of the die for ejecting the part.

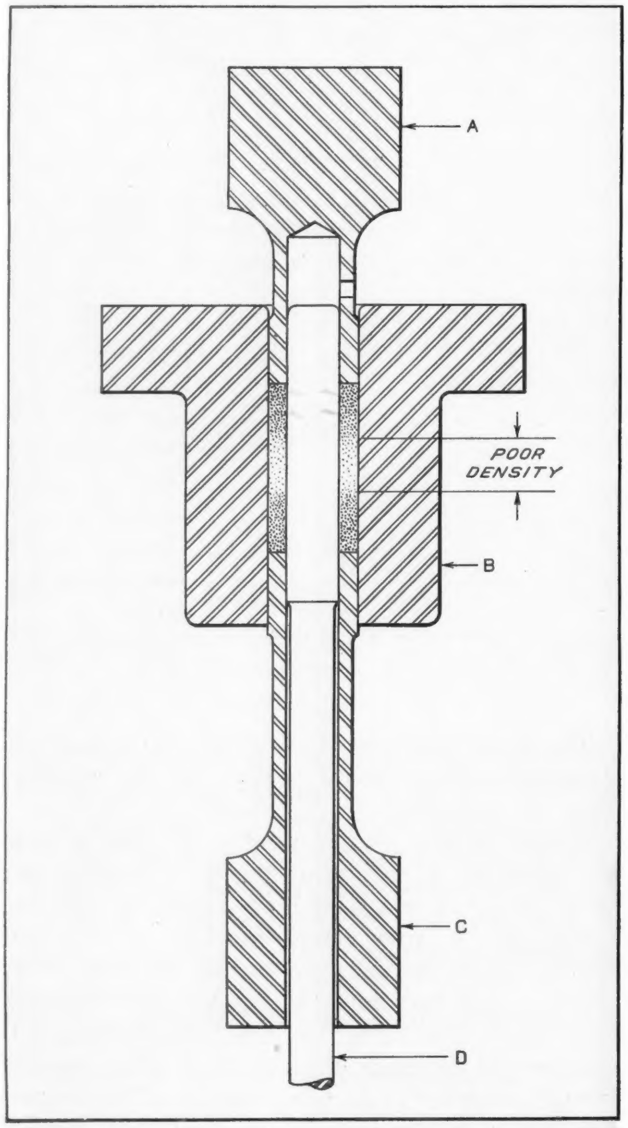


Fig. 4. Lack of proper density in center section of a long powdered-metal part often occurs when pressure is applied only by top punch (A)

In selecting a press for a given job, it is also necessary to decide whether a press with auxiliary rams is needed. Many presses for briquetting powdered-metal parts have inside rams that act independently of the upper and lower pressure rams. They are extremely useful for applying pressure to sections such as the center of the part shown in Fig. 3. Many times this inner action is built into the tools when such presses are not available, although this is a somewhat expensive procedure.

Another factor to be considered is the production schedule for the press department in a plant. Sometimes it is good practice to use adapters or to design tools for a press of greater capacity than is actually needed in order to relieve the load on a press that might have a large backlog of work. This will, of course, expedite production with no great sacrifice in operating efficiency.

Actual Design of the Press Tools

With the work drawing on hand, the rough sketch of the die made, and the proper press selected, the tool engineer is now ready to proceed with the actual design of the die. This should start with a scale lay-out of the press table and the upper and lower punch-holders. A cross-sectional assembly drawing should be made, showing one half of the die assembly at the finish of the pressure stroke and the other half at the top of the stroke. This enables the designer to readily determine the length of punches necessary, which should be kept as short as possible consistent with stroke requirements; the clearance between the upper punch and the powder filler shoe can also easily be seen, as well as the relative positions of the punches and other mechanisms.

For mechanical, cam-operated presses, a cam and work cycle should be laid out to aid in the design of the punches and their proper location at the fill, press, and ejection positions. Punches having irregular cross-sections, such as are required for forming gears, splines, etc., should be designed so that they are sufficiently long to

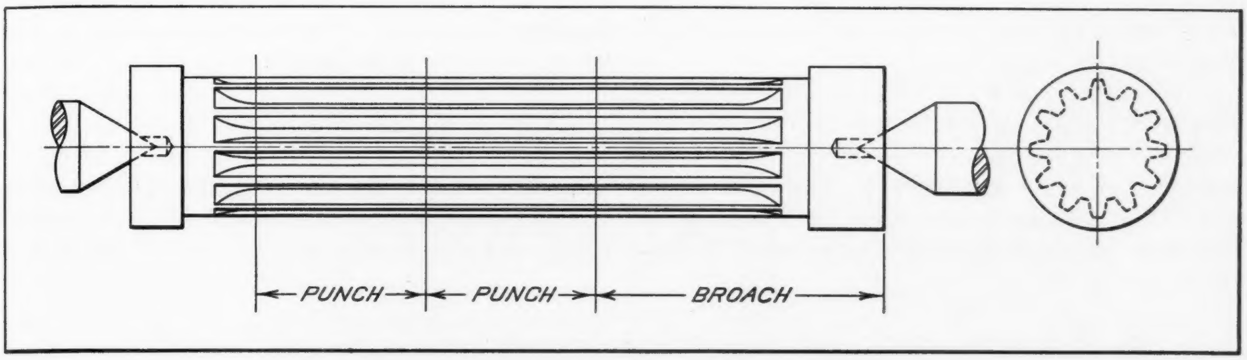


Fig. 5. Both upper and lower punches for producing powdered-metal gears, as well as a broach for making the die, can be constructed from one piece of stock

allow for grinding the faces in case chipping occurs, either from wear or misalignment. This often saves the cost of a new punch, and the expense involved in making the punches slightly longer is negligible.

An economical method of producing the tools for making a small spur gear is indicated in Fig. 5. It will be noted that both the upper and lower punches are made from one piece of stock that is long enough to include a broach for finishing the die. This piece could also be made sufficiently long to provide spare punches in case of breakage. Of course, irregular punches of this type are held in suitable sleeves or adapters when assembled with the die.

After the die has been completely designed, a dimensioned assembly drawing should be made, including all views and any special cross-section views that may be required, as in Fig. 6. In this illustration, the tools for the part seen in Fig. 2 are shown. This method of dimensioning shows the toolmaker which mating parts must be held to a close fit.

The separate views of the details give the allowable tolerances and other data needed. It will be noted that the diameter of the die cavity has been calculated on the basis of the lowest limits of the finished part dimensions, thereby making it possible for the die to wear larger to some extent before over-size pieces are produced.

Often the assembly time is greater than the time required to machine the tool details because the clearances between mating parts must be kept very small, and the parts usually require lapping. Punches and dies, for example, must fit closely in order to prevent flash around the edges of the pressed part. Another important reason for allowing a minimum clearance between these members is to prevent small particles of powder getting between the sides of the punches and die and causing wear.

The same close fits must be used for the mating surfaces of core-pins and punches. It will be noted in Fig. 6 that the punches and core-pins are relieved wherever possible to avoid high toolmaking expense in holding close tolerances for long lengths. This illustration also shows a die sleeve assembled with the die for forming a shoulder on the part shown in Fig. 2. Here, again, an extremely close fit must be maintained between the sleeve and the die, because it is possible for powder to be pressed into a very small clearance space, causing the part to tear at ejection. Moreover, if powder builds up in such an opening, the strain on the sleeve may cause it to crack.

It is good design, to use split dies for irregular-shaped parts wherever practical, as this reduces initial die costs. Also, the die sections can be ground on the split surfaces, in many cases, to correct the size of a worn die by making it smaller. This point should always be considered when designing dies from which many thousands of parts are to be made.

Fig. 7 shows how a square or rectangular die may be split at the corners, so that when the mating halves are ground the die opening will close uniformly. In designing split dies, special attention should be given to the anchoring of the die halves. The method of anchoring shown in

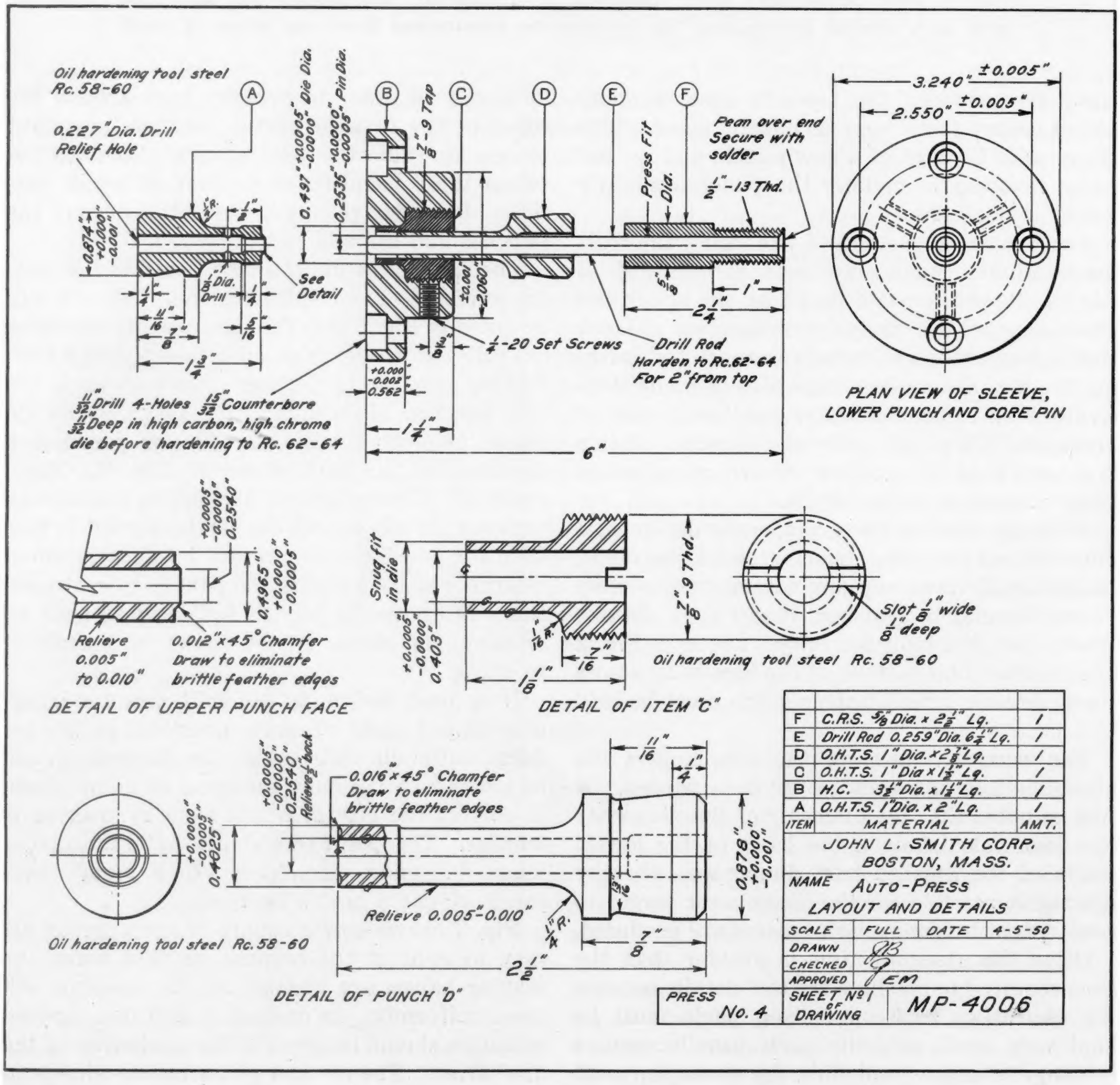
this illustration has proved the most rigid under heavy loads. This is known as the "box and ring" type of anchoring.

This assembly is a close fitting, self-contained unit, with the die sections a tight press fit in the retaining rings. The die is usually ground flat and square after assembly to eliminate high spots. The halves should always be ground after soldering to eliminate any dimensional variations and to aid in fitting the punches. This also removes lines on the pressed parts at the joints where the two halves meet.

Setting Up the Press for Trial Runs

Setting up the die and press for trial runs is one of the most important parts of the tool program, and should only be done by competent op-

Fig. 6. A typical tool lay-out comprising an assembly view of the entire set of tools, together with details and cross-section views, which facilitates making mating parts



erators under tool-room supervision. Few new tools can be set up and run in production without minor changes or adjustments of punch and die clearances, alignment, etc.

The recommended method of setting up a new die is to assemble the die barrel into the press table, install the top punch, and lower the press ram by hand to check the alignment of the punch and die as the punch enters the die, then raise the top punch to check the clearance between the bottom of the punch and the top of the powder filler shoe. The lower punch and core-pin should then be installed, and the lower punch brought up to the "fill" position, after which powder may be put into the die cavity.

Next, if the press is mechanical, the ram is lowered by hand, or "inched" down if it is hydraulic, to make a partial briquette. This procedure is repeated until the proper thickness, or length, and density of the part are obtained by gradually lowering the top punch or raising the bottom punch.

The die and punches should be inspected visually to see whether there is any galling, and if the operation is satisfactory, the press should be "inched" through a complete cycle several times. Density tests of the samples should be made, as the amount of powder fed into the die cavity automatically by the filler shoe might vary from that put in by hand. Sample briquettes should be broken open to inspect for bridging over of the powder and air-pocket inclusions.

If the samples meet the specifications, some should be sintered for final size checks, while others should be kept in the "green state" for checking the size and weight of new pieces in case a repeat order is received. The original "green" briquettes may be sintered with samples of the new order to compare the characteristics of the different lots of powder.

After the parts have been sintered and checked for size by the tool inspector, the tooling set-up should be turned over to the production supervisor, together with any special instructions necessary to insure that the tools will be operated carefully.

Design of Sizing Dies

The dimensions of many powdered-metal parts must be held to such close tolerances that ordinary control of dimensional changes in sintering cannot be relied upon. Parts of this type must be sized in a separate operation as must parts that require physical properties not ordinarily achieved by briquetting and sintering alone.

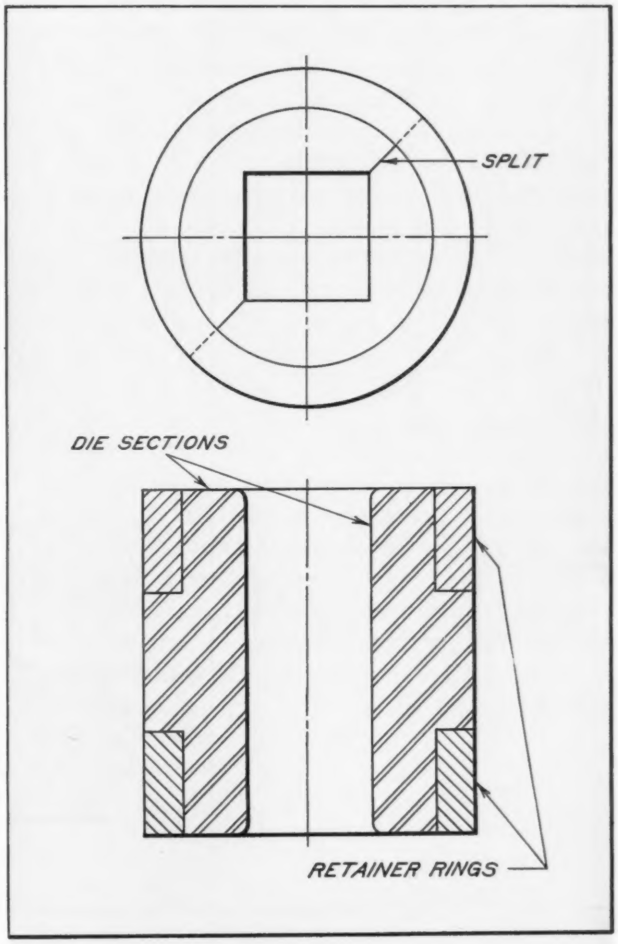


Fig. 7. Dies for producing square, rectangular, or irregular-shaped powdered-metal parts can often be made advantageously by splitting them and securely clamping the split halves as shown

A sizing die for an ordinary bronze bushing, the inside and outside diameters of which must be held to close tolerances, is shown at the left in Fig. 8. The sizing punch *A* is held in the upper ram of an ordinary punch press, while the die *B* is encased in a machine-steel adapter on the press table. The sintered bushing is placed in a nest on the die and forced through the die ring, which sizes the bore and outer periphery with little or no change in density. Parts of this type

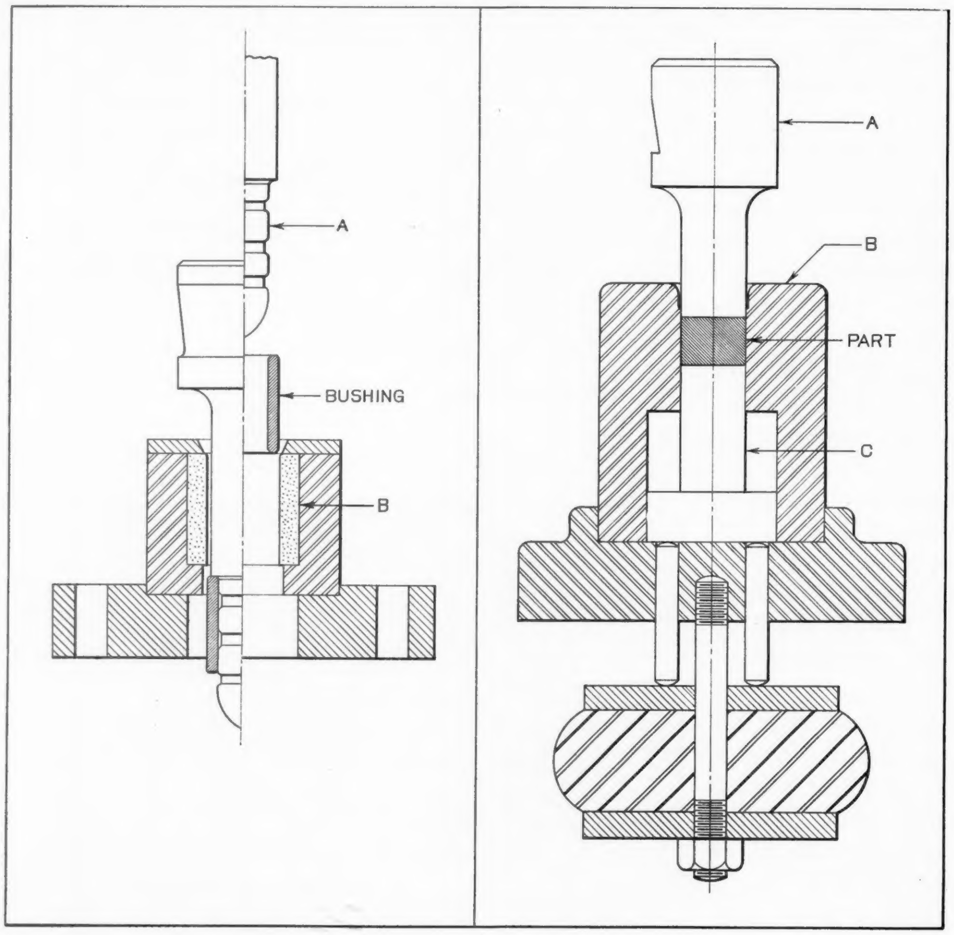


Fig. 8. Sizing dies for maintaining high dimensional accuracy in sintered powdered-metal parts are often used. The die at the left sizes the bore and periphery of a sintered bushing. Parts requiring increased density and strength are sized by dies of the type shown at the right

are usually impregnated with oil for use as oilless bearings.

A die for sizing a part to increase its density and strength is shown at the right. The cavity of this die is made to the finished dimensions of the part. The top punch *A* forces the piece into die *B*, after which it is ejected by lower punch *C*. A high degree of surface finish is obtained on the part with this type of sizing die.

Sizing dies are operated in ordinary punch presses, and the same load factors can be used as in producing stampings. The dies should be well lubricated, the usual procedure being to immerse the sintered parts in oil and kerosene prior to sizing. Indexing tables should be used for rapidly positioning the parts to be sized under the press ram if the quantity to be made is sufficiently large to warrant the cost.

Inasmuch as powdered-metal bushings are usually produced in a wide range of sizes, it is important, from the point of view of tool costs, to standardize the sizing tools. These are generally simple, round dies, designed with uniform outside diameters so that many different size dies can be assembled in one holder. Punch shanks should be made to a standard size for the same reason.

Selection of Punch and Die Materials

Because of the tremendous pressures used in briquetting, the main requirement for punch and die materials is physical strength, both in tension and compression; next to this come toughness and resistance to abrasion; and last high surface finish. Inexpensive temporary tools, or comparatively cheap materials, such as may be used for tools in the short-run production of other metal parts, have no place in the manufacture of powdered-metal parts, since the requirements are the same for one piece as for one hundred thousand, and the tools must be made from

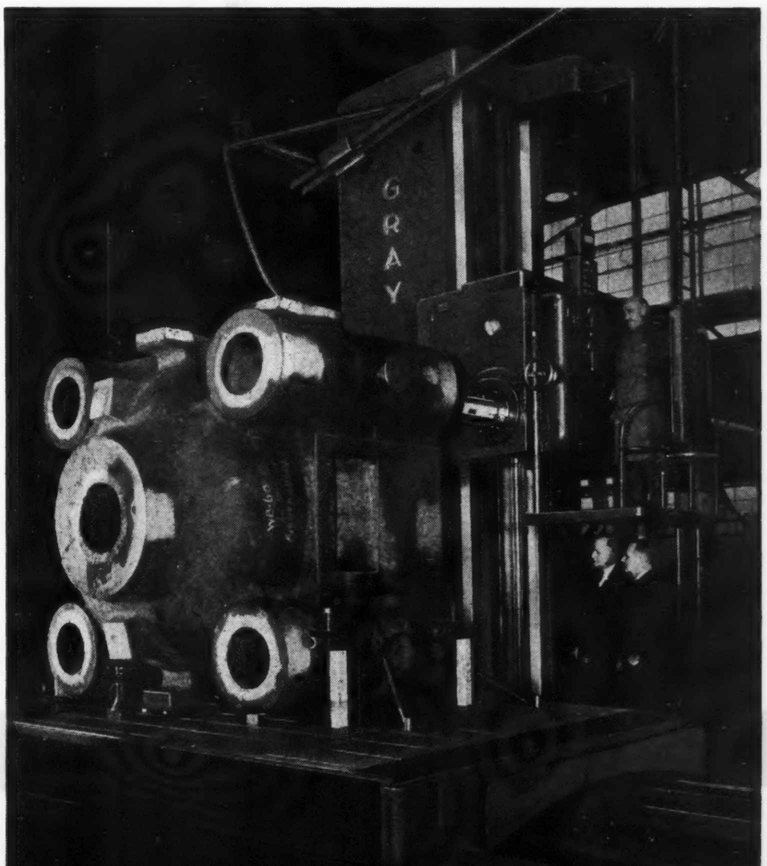
the best tool steels. Most manufacturers of tool steels will gladly furnish data on the type of steel to use for certain jobs, as well as the proper heat-treatment of the steel to obtain the best results.

Some manufacturers of powdered-metal parts have had excellent results by using graphitic tool steels which machine easily and resist deformation in heat-treatment. Many common grades of tool steel are successfully used for these tools with different types of heat-treatment. For example, a high degree of surface hardness in the bore, together with extremely tough walls, has been achieved by jet quenching round bushing dies. Hard chromium-plating of die walls is another means of obtaining an abrasion-resistant and highly finished surface.

The heat-treatment of a die depends to a great extent on the nature of the material to be pressed, since pressures and the degree of abrasion resistance required vary with different powders. The amount of lubricant used in the material to assist flow under pressure and prevent galling, for example, has considerable effect on these factors. Heat-treatment is usually more or less a cut-and-try procedure until sufficient data is obtained by experience with a particular powder to set a shop standard that will cover the materials used and the pressing equipment on hand.

For small, round parts that must be produced in large quantities, the use of tungsten-carbide dies is recommended. These should have thick walls and be well supported in the die-holder, because carbide has low tensile strength, compared with most tool steels, and if not properly supported will crack under load. Tests have shown that a carbide die will produce fifteen to twenty times the number of parts that could be obtained from a tool-steel die. Inasmuch as most shops purchase their carbide dies, a complete drawing of the die is necessary, specifying the finish required in the bore, as well as the grade of tungsten carbide desired.

While this article does not attempt to cover all the problems encountered in the design of powdered-metal pressing dies, it is hoped that it will serve to point out some of the basic considerations governing this work.



Cast-steel cylinder weighing 97,500 pounds being machined on a Gray horizontal boring mill in the plant of the Hydraulic Press Mfg. Co. This machine, which is part of a tool modernizing program, will handle castings up to 170,000 pounds in weight. Executives watching the operation of the machine are Howard M. Hubbard, president, and E. V. Crane, chief engineer, of HPM

Checking Diameter of Taper Plug Gage at Small End

By CHRIS FETTE

A METHOD of checking the diameter *ab* of the small end of a taper plug gage is shown in the accompanying illustration. The gage is mounted on a sine bar which is positioned so that the top of the gage is parallel with the surface plate on which one end of the sine bar rests. A disk or cylinder of known radius *r* is then placed on top of the sine bar, against the end of the gage as shown.

By measuring the distance *x* from the top of the disk to the top of the plug gage, the accuracy of diameter *ab* can be readily checked. Thus the value of *x* for a given diameter *ab* is found by the following formula:

$$x = \left[ab - 2r \cot\left(\frac{90 \text{ deg.} - \frac{A}{2}}{2} \right) \right] \cos D$$

Derivation of Formula

$$x = de = ad \cos D \qquad (1)$$

But

$$D = B = \frac{A}{2} \qquad (2)$$

Hence

$$x = ad \cos \frac{A}{2} \qquad (3)$$

$$ad = ab - db \qquad (4)$$

$$db = 2(oc \cot C) = 2r \cot C \qquad (5)$$

But

$$C = \frac{90 \text{ deg.} - B}{2} = \frac{90 \text{ deg.} - \frac{A}{2}}{2} = 45 \text{ degrees} - \frac{A}{4} \qquad (6)$$

Hence

$$db = 2r \cot\left(45 \text{ degrees} - \frac{A}{4}\right) \qquad (7)$$

and

$$ad = ab - 2r \cot\left(45 \text{ degrees} - \frac{A}{4}\right) \qquad (8)$$

Then

$$x = \left[ab - 2r \cot\left(45 \text{ degrees} - \frac{A}{4}\right) \right] \cos \frac{A}{2} \qquad (9)$$

Example—What should measurement *x* be for a diameter *ab* of 2.4000 inches, a disk radius *r* of 1 inch, and an angle of taper *A* of 6 degrees?

Solution—

$$x = \left[2.4000 - 2 \cot\left(45 \text{ deg.} - \frac{6 \text{ deg.}}{4}\right) \right] \times \cos \frac{6 \text{ deg.}}{2} \qquad (8)$$

$$x = (2.4000 - 2 \cot 43\ 1/2 \text{ deg.}) \cos 3 \text{ deg.}$$

$$x = (2.4000 - 2 \times 1.0538) \times 0.99863$$

$$x = 0.2924 \times 0.99863 = 0.2920 \text{ inch}$$

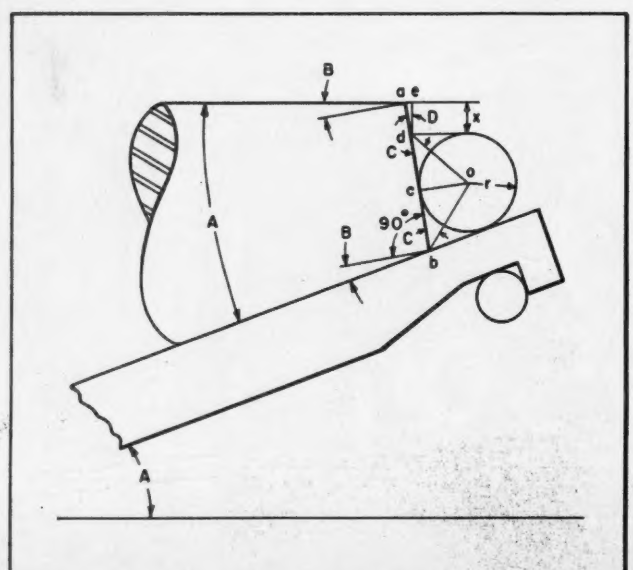


Diagram illustrating method of checking the diameter (ab) of the small end of a taper plug gage by measuring the distance (x) from the top of a disk of known radius to the top of the plug gage

The Machine Tool Industry and Our National Economy

AMERICA'S economy — our high standard of living—has been derived directly from the ingenuity and progressiveness of the manufacturers of machine tools and allied equipment. This is true because the foundation of all other industries, whether automotive, steel, agricultural, textile, or chemical, is the productive machinery which they employ —machinery built by machine tools.

Although the machine tool industry is of inestimable importance to the economy of our nation, it is a relatively small industry judged by the annual output in dollars and cents. During the war, annual sales reached an all-time peak of $1,320,000,000, but before the war the maximum was $220,000,000, and that was reached during the first World War. Today the industry has an annual plant capacity of about $600,000,000. Last year, total sales amounted to only $250,000,000, which meant that quite a few companies were operating in the red. Business has been showing an improved trend during the last few months, and if it holds up as anticipated, sales this year will be between $300,000,000 and $325,000,000. At the latter figure, practically every company should be making a profit.

In past years, most machine tools were sold to equip new plants for manufacturing consumer goods. Today there is not a great deal of such expansion going on. But there is another enormous potential source of business for the builders of machine tools and allied equipment to which advertisements should be pointed right now. That is the replacement of obsolete equipment. Machine tool builders have made spectacular progress since the war in the improvement of machine designs that were frozen during the war period. General industry has been slow to buy these modernized machines, even though they would soon pay for themselves in reduced production costs and higher product quality.

And so industry has been plugging along with a great deal of metal-working machinery that has long been obsolete. For example, the majority of planers in use today are over ten years old. Machines of that age are driven at speeds ranging from only 20 to 120 feet per minute. Today's planers, with carbide tools, will readily operate at cutting speeds around 200 feet per minute. Similar startling comparisons could be made between obsolete and modern machine tools of almost every type. Actually, there are about 380,000 machine tools over twenty years old in use in the United States. This is an alarming situation in view of the mounting costs of labor and materials.

Advertising men of the machine tool and shop equipment industry have an opportunity to make a real contribution to the national welfare by directing their efforts toward reducing obsolescence in metal-working shops. Through advertisements they can make an effective appeal to the mechanical executives who have the authority to replace obsolete machinery with modern equipment. The advertisements should avoid general statements, and show how the new equipment would pay for itself in short order.

If the men who are responsible for machine tool advertising will write convincing copy, they will help materially in boosting the sales of machine tools, bring a high level of prosperity to the industry, and promote the national economy. Finally, they will help to keep the machine tool industry in the state of preparation necessary to turn out the huge numbers of machine tools that will be required in case of a national emergency.

Charles O. Herb
EDITOR

Excerpt of a talk given by Mr. Herb at the twenty-eighth annual conference of the National Industrial Advertisers Association, Los Angeles, Calif., on June 29.

Determining the Machinability of Metals

By GERALD LEWIS
Assistant Chief Engineer
Vanton Equipment Corporation

A Knowledge of the Relative Machinability of Metals Helps to Improve Cutting Tool Designs and Speeds Machining Operations. The Application of a Shop Instrument for Testing This Property of Metals is Described Here

MANY manufacturers in the metal-working field have found machinability ratings of ferrous and non-ferrous metals valuable as a means of determining production rates, the power requirements of shop equipment, and other factors related to efficient shop operation. To facilitate the determination of this characteristic of metals, a machinability tester suited for use by workers of average skill has been introduced by the Vanton Equipment Corporation, New York City. This simple instrument, known as the MSE-Schlesinger machinability tester, rapidly measures the two basic characteristics of the machinability of a material. These are the specific cutting resistance, representing the work done by the tool on the material, and the abrasive effect of the same material, representing the wearing effect of the material on the tool.

The product of these two factors is a machinability index, which indicates the effort required to machine a given material and can be used to compare the relative machinability of various metals. This index permits a predetermination of tool life and the establishment of the most economical speeds and feeds for a given job.

By using the tester to determine the lowest cutting resistance for a particular combination of cutting tool angles, it is possible to establish an optimum cutting tool shape. With specific knowledge of the greatest tool life possible for a particualr set of conditions, the number of cutting tools necessary to produce a given number of units for any volume of production can be determined.

The instrument can also be used for testing machinability in connection with normal material inspection or quality control procedures so as to insure uniformity of free-cutting qualities.

Many of the labor-management difficulties arising in a manufacturing enterprise are due to the fact that wage rates are based on incorrect machining rates. With the new machinability tester available to the time-study, methods, and wage-rate departments, over or under estimating of the time for a particular job will be kept to a

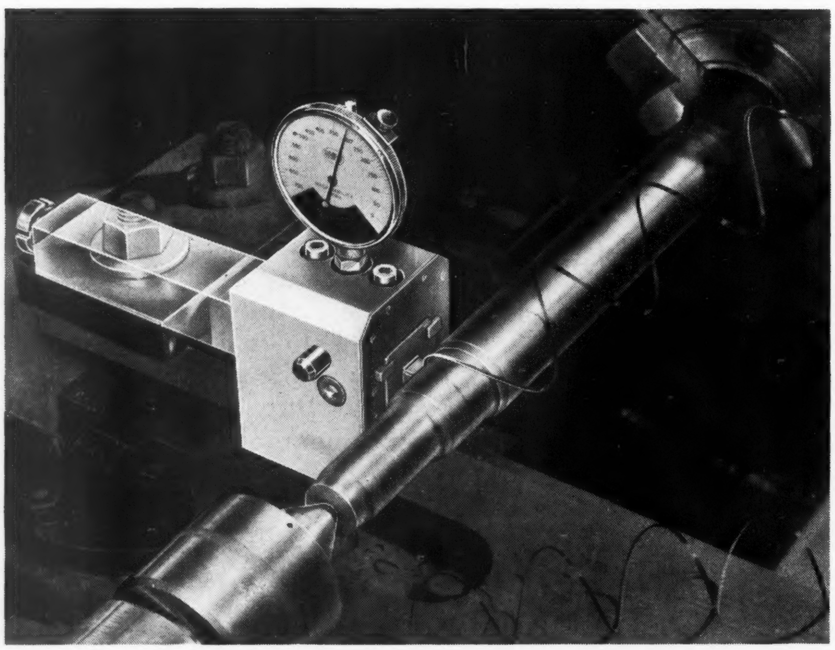


Fig. 1. Determining the cutting resistance of a material is easily accomplished with the MSE Schlesinger machinability tester on a lathe

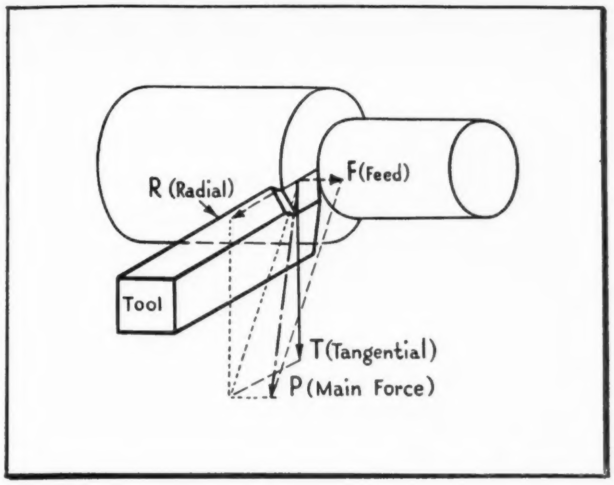


Fig. 2. Cutting resistance is measured as the tangential force (T) exerted by the material against penetration of a standardized kind and shape of sharp cutting tool

minimum, and any change in operational methods can be justified to the satisfaction of both management and labor.

Another application of this instrument is in studying the effect of cutting oils on a machining operation. This tester provides a sound basis for demonstrating rapidly the effects of cutting oils or coolants on cutting force, abrasion, and tool life.

To obtain the first factor in determining the machinability index of a material with the Schlesinger tester, cutting resistance is measured as the tangential force exerted by the metal against penetration of a standard kind and shape of sharp cutting tool. Fig. 1 shows the instrument mounted on a lathe for making this test. The dial indicator is calibrated to give a direct reading in pounds per 0.001 square inch, in order to provide a direct measurement of the tangential force perpendicular to the tool.

The force diagram, Fig. 2, illustrates the composition of forces about the cutting edge of a standard turning tool. Before designing the machinability tester to isolate the tangential force *T* for measurement, a thorough investigation was made of the specific pressures caused by resistance to cutting action for a wide range of typical materials. This covered different cross-sectional areas of chips and included a thorough analysis of the component forces (tangential, radial, and axial) of the main cutting force *P*.

Analyzing these three component forces, it was found that for a given tool under proper cutting conditions, the radial force *R* and the axial force *F* remain in constant proportion to the tangential force *T*. Also, since the axial and radial forces act either perpendicular to the plane of torque (axial force) or within this plane (radial force), they do not consume any perceptible power. Therefore, tangential force, so far as power consumption is concerned, is the only force that need be considered.

In the cutting resistance test, bars of different diameters and about 10 inches in length may be used. They are supported at the end by means of a center, as illustrated in Fig. 1. Speeds may vary from 100 to 400 surface feet per minute with only a negligible effect on the cutting resistance factor. This is due to the fact that the tangential force *T* remains constant for all these speeds.

To keep the tool as sharp as possible in making machinability tests, it is recommended that carbide tools be used at a speed of not less than 100

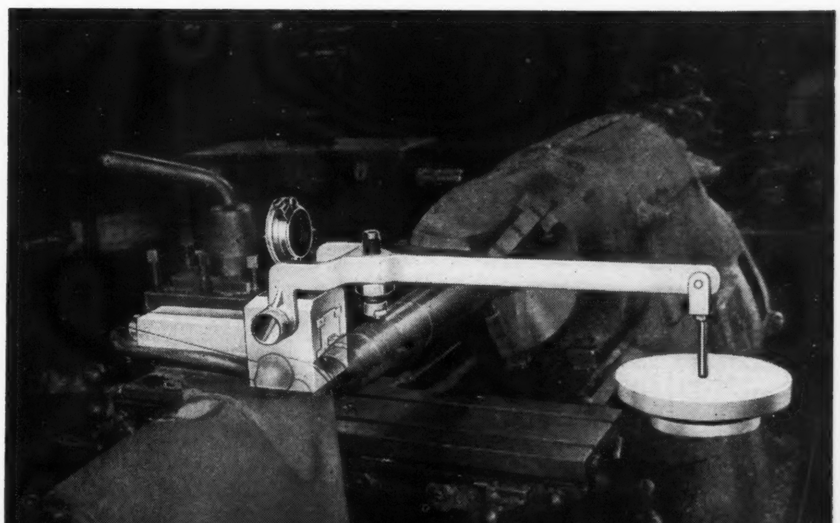


Fig. 3. Determining the abrading effect of the material by the use of a standard shop lathe. A hardened steel ball is held in contact with the work under a known pressure and for a given length of time. The resulting elliptical flat on the surface of the ball is measured to obtain the abrasion factor for the material

surface feet per minute. It is essential to the success of the test that the shape of the tool be standardized according to the material to be cut. Eight tool forms have been selected as sufficient for the majority of ferrous and non-ferrous materials used in the average shop.

The standard test area of chip should be 0.001 square inch, maintaining a ratio of about 4 to 1 between the depth of cut and the feed. For this chip area, the depth of cut is 1/16 inch and the feed 1/64 inch. This small chip area and the resulting small tangential force make it possible to carry out the test with 2 to 3 horsepower consumption—that is, with machines available in every shop.

After the dial indicator has been set to zero and the test cut made, the indicator will show the cutting resistance factor T directly. This figure, multiplied by the abrasion factor A, to be described, equals the Schlesinger machinability index I.

Determination of the abrasive effect of the work material on the tool is quite different from the consideration involved in measuring the cutting force. Different steels may have approximately the same cutting resistance but may vary decidedly in abrasive quality. As an extreme example, copper has a cutting resistance factor of only 100 pounds per 0.001 square inch, but its abrasive effect on the cutting edge of the tool is far greater than that of hard steel.

The Schlesinger machinability tester measures abrasiveness by using a bar of the material to be tested as an abrader. A standard hard steel ball of 10 millimeters diameter is used as a calibrator. The ball is held stationary under 40 pounds pressure while in contact with the rotating work for twenty seconds. The standard test speed for the material is 400 feet per minute. A magnifying glass having graduations in millimeters is supplied with the tester for measuring the small axis of the resulting elliptical flat on the surface of the ball, which indicates the abrading effect of the material. The equipment for this test is shown on a lathe in Fig. 3.

To obtain the abrasion factor A used with the cutting resistance factor T for determining machinability index I, the graph shown in Fig. 4 is employed. It can be seen that the abrasion factor A is read directly from length L. This data, compiled after many tests, is also supplied with the tester in tabulated form.

Cutting speeds, tool life, and other factors can be correlated with the machinability index by means of graphs to provide a quick and simple method of determining these factors for different conditions. For example, a graph based on the machinability index of a particular material can be made up to show the cutting speed permissible for the desired life of a selected type of tool.

* * *

Recent advances in methods of applying metallic and non-metallic coatings to gray iron castings have revolutionized previous ideas regarding the possible fields of application of iron castings. Coatings of any desired metal can now be produced by molten metal spraying, dipping the castings in molten metal, heating in molten metallic salts, electroplating using improved techniques, or deposition of the required surface metal by oxy-acetylene or arc-welding methods. Non-metallic coatings are best applied by spraying, brushing, or dipping.

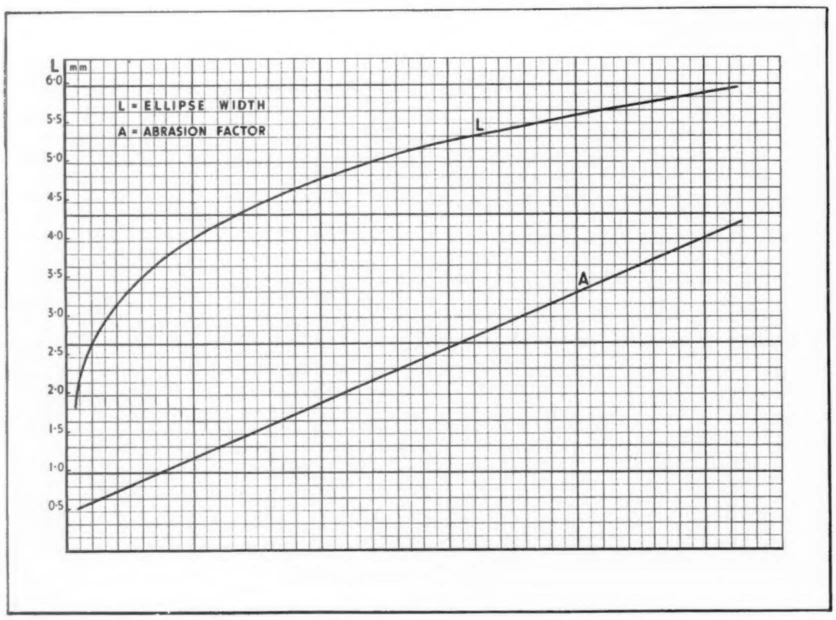
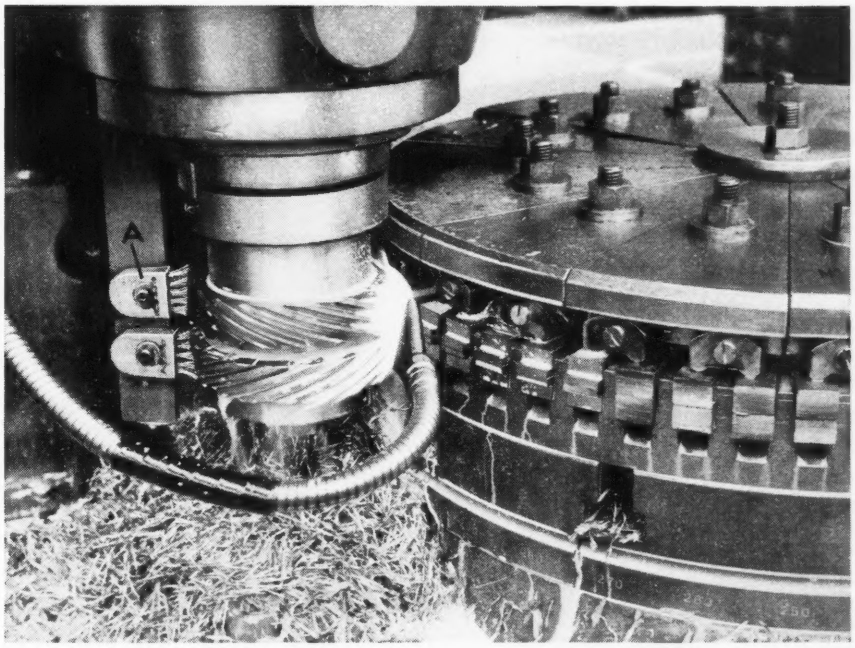


Fig. 4. Graph for obtaining abrasion factor (A) from the width (L) of the ellipse produced on a hardened ball by the abrasion test

Machining Aircraft Turbine Blades

Techniques and Special Equipment Employed by the Bristol Aeroplane Co., Ltd., England, in Machining Nimonic Alloy Blades for Propeller-Turbine Aircraft Engines — First of Two Installments



SPECIAL techniques are required in machining the heat-resisting alloys from which aircraft turbine blades are produced, and it has been necessary to develop suitable equipment in order to secure satisfactory results on this class of work. Methods and tooling used by the Bristol Aeroplane Co., Ltd., of England, in machining blades for propeller-turbine type aircraft engines will be described in this and a subsequent article.

Turbine blades, which are required for both the compressor and propeller driving wheels in this type engine, are machined from blanks of a high-temperature-resistant, chromium-nickel alloy known as "Nimonic." This austenitic material contains approximately 74 per cent nickel, 21 per cent chromium, 2.50 per cent titanium, 0.7 per cent aluminum, and 1.8 per cent iron.

Progressive stages in the production of aircraft turbine blades, from blank to polished blade, are shown in Fig. 1. The material, which is received in the form of rectangular bars, is cut into blanks of the required length on a Radiac abrasive-wheel cutting-off machine. A step is milled at one end of each blank, as seen at *A*. This step facilitates holding the work for the external form-grinding and concave form-milling operations which follow.

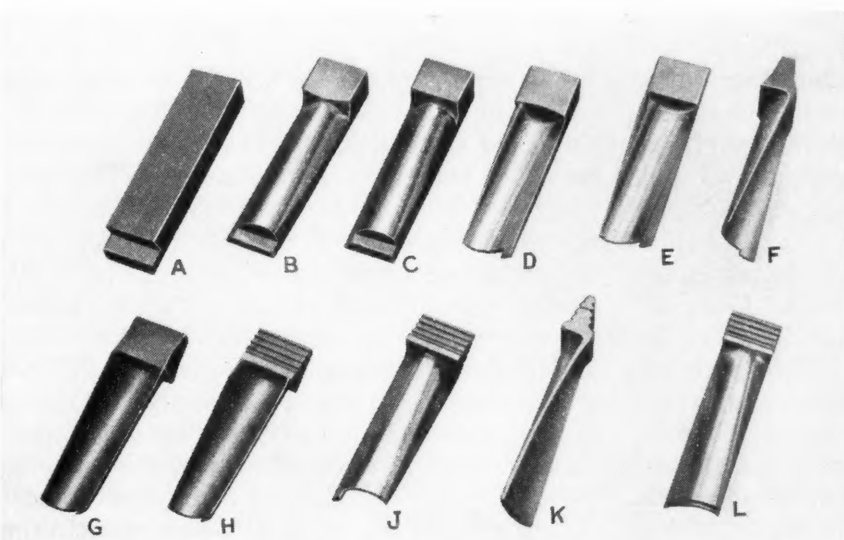


Fig. 1. Progressive stages in aircraft turbine-blade production, from blank of Nimonic heat-resistant alloy seen at (A) to polished blade shown at (L)

Milling the Step on the End of the Blade

The step-cutting operation is performed on a standard Cincinnati No. 3 vertical milling machine, equipped with a rotary table as shown in the heading illustration. The table supports a special fixture with a circular cast-iron body in which there are sixty radial slots. Each of the radial slots accommodates two work-pieces, so that the fixture, when fully loaded, carries 120 blanks.

In operation, the table rotates continuously, the work being fed past the cutter at a rate of 3 inches per minute. Loading and unloading are carried out while machining is in progress. Fixed stops locate the blanks endwise in the radial slots, and fifteen segmental clamps, operated by bolts, hold the work-pieces in position, each clamp carrying a pair of equalizing plates. As every plate covers a pair of slots, eight work-pieces are held by each clamp.

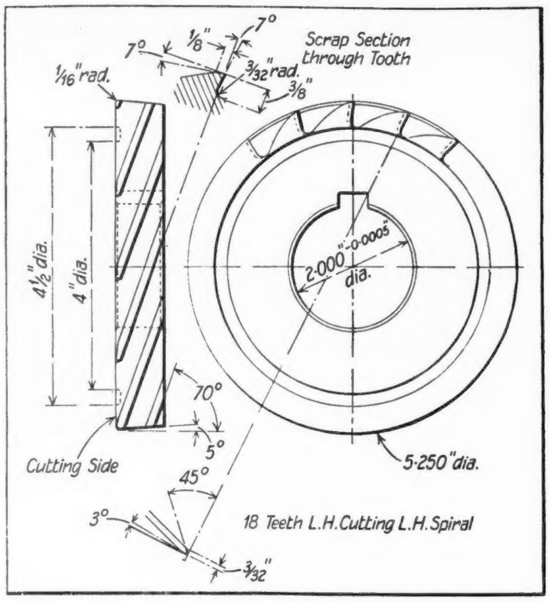


Fig. 2. One of two cutters used for step-milling turbine blades. The second cutter is similar but the spiral and direction of cutting are of opposite hand

The work-pieces are straddle-milled by a pair of cutters. The cutters are 5 inches in diameter, and are run at a surface speed of 37 feet per minute. The cutters are spaced apart a distance equal to the thickness of two of the steps on the blanks, and are mounted at such a height that steps of uniform dimensions are obtained. With this arrangement, cutter wear can be compensated for by the use of suitable spacing collars on the arbor.

One of the two milling cutters used in this operation is shown in Fig. 2. The other cutter is similar, but the spiral and direction of cutting are of opposite hand. These cutters are of particular interest in that they exemplify some of the features that have been found to be important in milling Nimonic.

The cutters are made from 18 per cent tungsten, 5 per cent cobalt high-speed steel. Cemented carbides have so far proved unsatisfactory for machining the Nimonic alloys. High-speed cutting with negative rake is impossible, although in certain instances, good results are obtained with special types of end-mills having left-hand spiral angles and a right-hand cutting direction.

As the Nimonic series of alloys is particularly sensitive to work-hardening, continuity of cut is of vital importance. Excessive backlash or chatter is fatal to good results; hence, it follows that the milling machine employed must be in good condition and of ample power, while overhang of cutters must be kept to a minimum. To eliminate the possibility of work-hardening due to rubbing, care must be taken in the design of the cutting edges of the tools, and it is important that the edges be kept sharp.

Wire brushes, such as shown at *A* in the heading illustration, are fixed to an arm at the side of the spindle head, in order to prevent chips from adhering to the cutters and causing jamming. Solcut cutting oil is employed as a coolant in this operation. The average number of blanks step-milled before cutter sharpening becomes necessary is 500 to 600, the maximum life between grinds so far recorded being 700.

Grinding the Convex Form on the Blade

The convex form of the blades is produced on specially adapted centerless grinding machines. The principal modification made in these machines is the removal of the control wheel-heads and the substitution of special pneumatic, cam-operated profiling attachments. A close-up view of one of the machines, showing the grinding wheel in engagement with the work, is seen in Fig. 3.

The work-carrying portion of the attachment comprises a horizontal shaft *A*, shown in the simplified sketch Fig. 4, at each end of which a cam *B* is mounted. At the center of the shaft there is a block *C* to which the work-piece is clamped, as shown in Fig. 3. A system of shafts and universal joints transmits the drive to the shaft from a 3/4-H.P. motor. The shaft bearings are carried by a member which has a swiveling motion about a vertical axis at the point *E*, Fig. 4, and the bearing in which the member swivels is, in turn, mounted on a slide having a movement at right angles to the spindle of the grinding wheel *F*.

Connecting-rods attached to pistons operating in a pair of pneumatic cylinders are coupled to

bearing blocks on the shaft. These hold cams *B* in engagement with the fixed rollers *J*, the combination of longitudinal and swiveling motions causing the shaft to move as required. By utilizing suitable cam forms, it is possible to produce any shape of blade desired, the straight-line contact of the grinding wheel insuring correct blending of the root and tip profiles over the entire blade length.

The blade is located in a recess in block *C* for grinding, and simple clamps engage the root end and the step milled at the opposite end. Heavy cuts are taken from the trailing to the leading edge of the blade. When the cut begins, the work is positioned below the wheel center, and as the cut proceeds, it rises above the center, being lowered to the starting position again at the completion of the cutting movement while it is out of contact with the wheel.

The number of cuts varies according to the type of blade being ground. The first cut removes the bulk of the material, leaving 0.005 to 0.030 inch for finishing, depending upon the number of cuts required for the particular type of blade. The wheel is dressed to a depth of approximately 0.005 inch after every two blades have been ground. The grinding wheel has a nominal diameter of 21 inches and a variable width to suit the blade length, the action being one of plunge-grinding. Aluminum-oxide abrasive of 16 grit, with a resinoid binder, is employed for the wheel.

This is a much coarser wheel than those normally used for producing accurate profiles, but the resulting form and finish are quite satisfactory. The success of the operation depends upon the use of a generous supply of coolant and the maintenance of a speed of approximately 9000 feet per minute. Coolant is directed to the cutting point of the wheel during the operation at the rate of about 75 gallons per minute.

Hand control is employed for disengaging the shaft drive and returning the work to the starting position after each pass, and a small micro-switch, actuated by a cam on the shaft, automatically stops the rotary movement as each pass is completed. An air cylinder provides for withdrawing the work-head to clear the wheel-head at the end of each cycle, thus facilitating unloading and reloading.

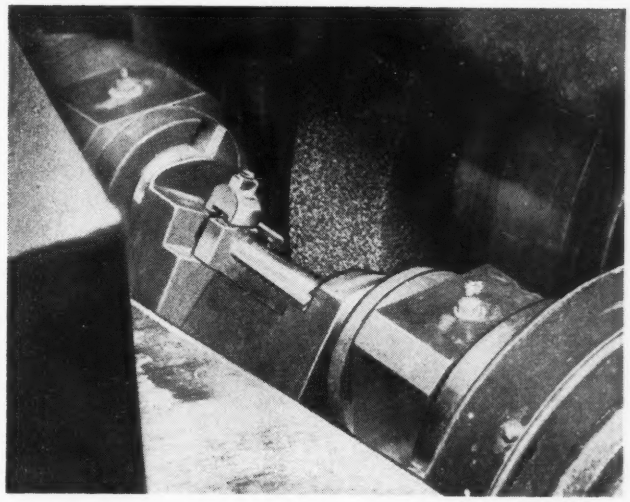


Fig. 3. Close-up view of the modified centerless grinding machine employed to produce the convex form on turbine blades

The combination of movements employed when the convex form of the blade is being ground makes it impossible to obtain a root face, or platform, which is perfectly square. A slightly curved surface results, as shown at *B* in Fig. 1, and to correct this and obtain the form indicated at *C*, an additional grinding operation is necessary. This is carried out on the Churchill grinding machine illustrated in Fig. 5.

Cam-Controlled Work-Holding Fixture Used in Grinding the Root Face Square

The work-spindle of this machine carries a five-station blade-holding fixture *A*, to which a cam *B* is fixed, and is driven by a worm and worm-wheel. The work-spindle carrier is mounted on bearings in such a manner that the spindle, with the work-holder and cam, may swing through an arc, the bearings being parallel with those of the grinding-wheel spindle. The weight of the work-spindle carrier assembly tends to rock the carriage toward the grinding wheel, the movement being controlled by the roll *C* and cam *B*. Thus, as the work-holder rotates, the work-pieces are so moved in relation to the grinding wheel that the form of the cam lobes is reproduced on them.

The blade blank is positioned flat face down-

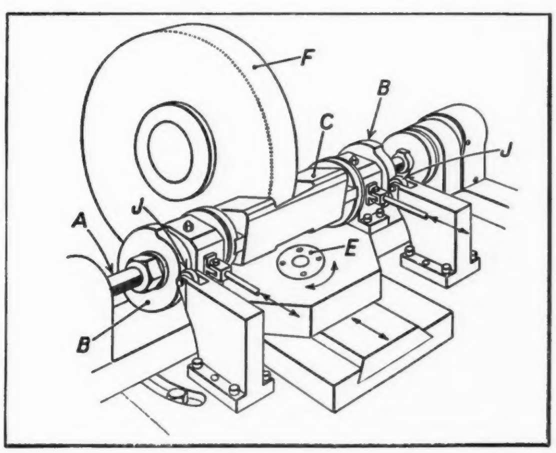


Fig. 4. Special work-holding fixture and pneumatic, cam-operated profile attachment used on centerless grinding machine seen in Fig. 3

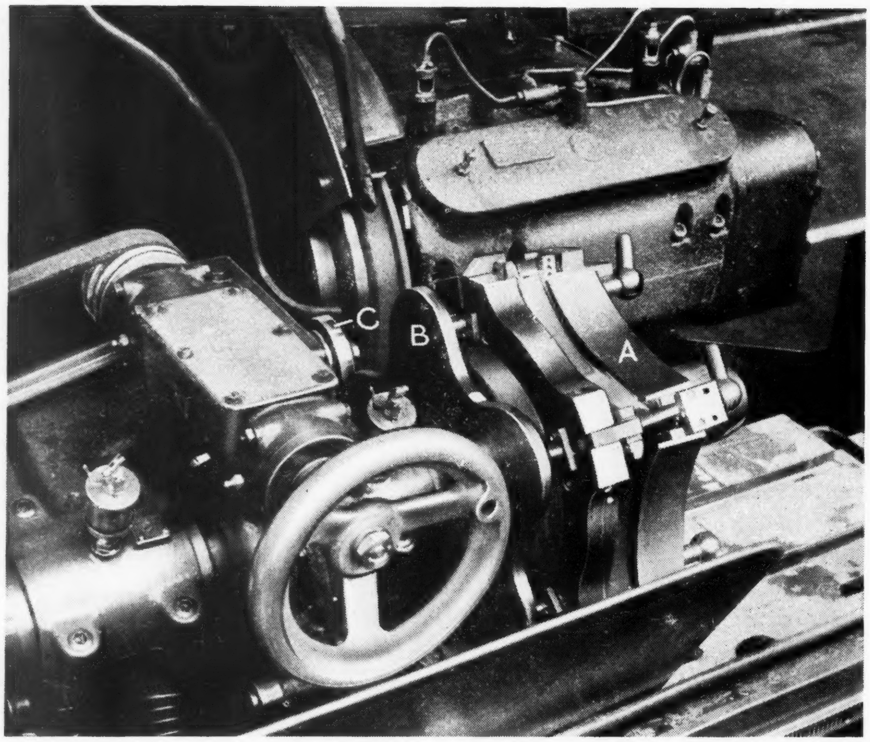


Fig. 5. Cam-controlled work-holding fixture employed on a grinder to complete the external profile of the turbine blade at the root end

ward, initial location against fixed points being obtained by means of ball-ended spring-loaded plungers. A threaded push-rod passing through the body of the fixture actuates a rocker type clamp, which engages the root end of the part to apply the main clamping pressure, a combined endwise and downward force being exerted at the tip by the spherical-ended plunger that engages the step. Loading and unloading take place while the wheel is cutting, the machine operating continuously.

One corner of a 60-grit, vitrified-bond, aluminum-oxide abrasive wheel is employed for this operation. The required form on the grinding-wheel corner is maintained by the use of a special dressing device shown in Fig. 6.

The base of the dresser is secured to the table of the grinding machine, and carries a bracket formed with ways for the slide, which is moved by a rack-and-pinion motion through the hand-wheel *A*. The carrier for the diamond *B* is controlled by a pantograph mechanism operating in conjunction with a pair of identical former plates *C* and a single former plate *D*, which are held by the same bolts and separated by spacers.

The main pantograph member at *E* carries a pair of rolls *F* which engage the former plates *C*, contact being maintained by the thrust arm *G*, which is spring-loaded as shown. A roll *H*, carried by the member *J*, engages the former plate *D*. This member is pivoted at *K* to the main pantograph member *E*, and connected to the

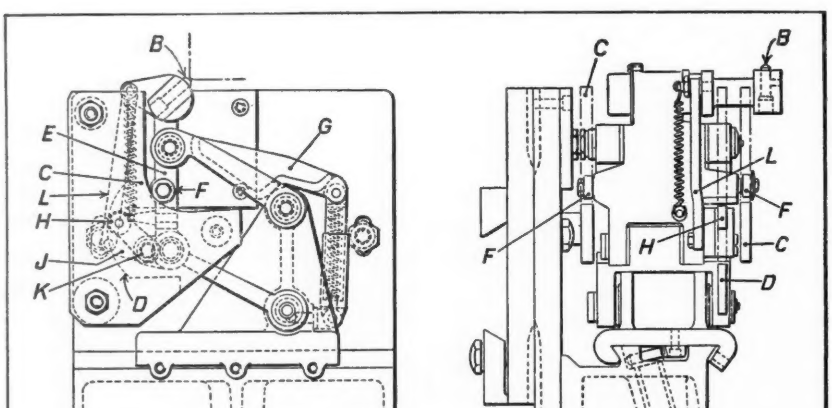


Fig. 6. Special dressing device for maintaining the required form on the grinding wheel used in completing the external profile of turbine blades

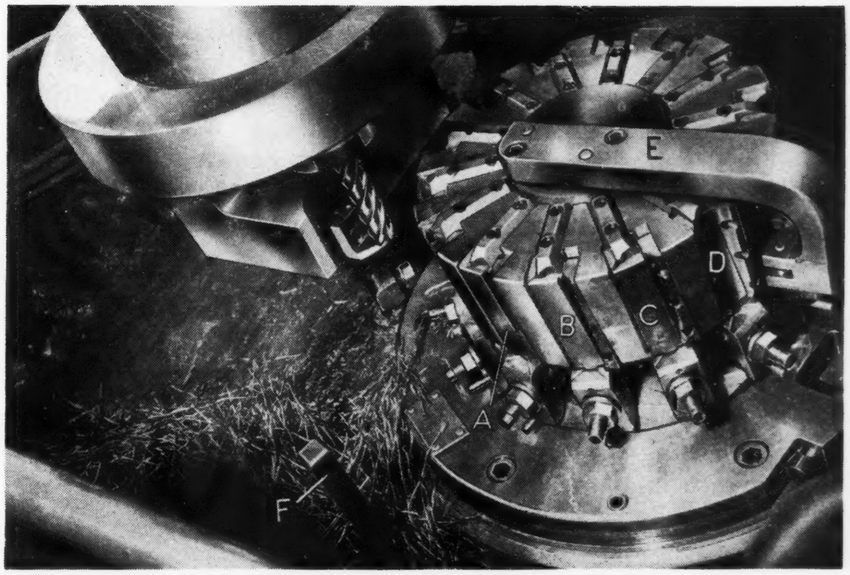


Fig. 7. Set-up employed on a specially adapted profile milling machine for machining the concave form on the turbine blades. An outboard support is provided for the spiral milling cutter

diamond-holder by a link *L*, a tension spring maintaining contact between roll *H* and former plate *D*.

As the handwheel is turned, the rollers travel along their respective former plates, plates *C* thus controlling the direction of travel of the diamond-holder, while plate *D* governs the rotation of the holder so as to maintain the diamond at the correct angle to the wheel profile. The diamond-carrier swivels in a plain taper bearing, a spring washer serving to hold the bearing surfaces in contact.

The grinding machine shown in Fig. 5 is used for making or truing its own cams. When such operations are to be performed, master shapes are substituted for the work-pieces, the grinding wheel is replaced by a blank disk, and the follower roll is replaced by a grinding wheel, which thus engages the profile of the cam being ground. As the cam spindle rotates, the rocking motion of the carrier is controlled by the master shapes in contact with the disk, the forms of the masters being thus reproduced on the lobes of the cam.

The concave surfaces of the turbine blades are milled on Snyder special-purpose profiling machines with the set-up shown in Fig. 7. The bed of the machine has an inclined top to facilitate loading and unloading and to assist in the disposal of chips. The work-fixture spindle, cutter-head, and column are similarly inclined. The column has a limited swiveling movement to carry the spindle head through an accurate path, thus feeding the helical cutter toward the work fixture and retracting it as required.

The spindle of the work-holding fixture is rotated by worm-gearing driven by an independent electric motor. A cam at the lower end of the spindle is engaged by a roller follower on an arm attached to the lower end of the column. Contact between the roller follower and the cam is maintained by a hydraulic ram, the roller being positioned coaxially with the cutter. The multi-lobe cam corresponds to the multi-station fixture, the arrangement being such that as the work-fixture and cutter rotate, the cutter is caused to oscillate, the spindle axis approaching the work-fixture spindle axis and receding from it in a regular and continuous cycle.

An interesting modification has been made in the machine to provide a convenient means of adjusting for the depth to which the cutter is fed into each work-piece as the operation proceeds. The cutter-head arm is mounted on a circular plate which is supported on a plate attached to the column. By operating the handwheel, the cutter-head arm plate is rotated a few degrees, and thus the cutter-head may be brought nearer to the fixture or moved farther away from it.

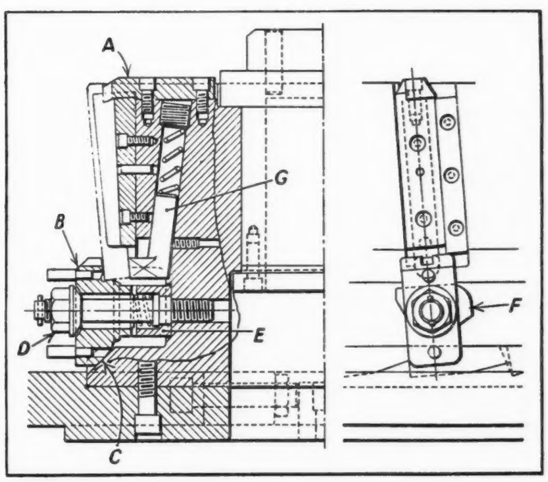


Fig. 8. Part-sectional view of the work-holding fixture for milling concave form on turbine blades. The fixture accommodates fourteen blades

To insure that the surfaces are accurately positioned, the blades are located in the work-holding fixture by special matrices, which engage the previously ground convex profiles. It is possible to apply clamping pressure only at the root end, as the entire blade beyond the root must be accessible to the cutter. Moreover, the clamping pressure must not distort the work.

Another difficulty is presented by the fact that at this stage, the root is not machined, and there is, therefore, no fixed relationship between the root surfaces and those of the blade. Positive support must, however, be provided for the root to avoid bending the blade. The work-holding fixture shown in Fig. 7 accommodates fourteen blades, and loading and unloading are performed while the machine operates continuously. Loaded blanks are shown at *A*, *B*, and *C*, while a finish-milled blade, ready for removal, is seen at *D*.

An auxiliary loading clamp is used to insure that a uniform pressure will be exerted on the blades while the clamping members are being brought into operation. This clamp is mounted at the end of an arm *E*, which is pivoted at the center of the fixture. It is toggle-operated and applies direct pressure on the unmachined face of the blank, thus insuring that the ground convex form is held tightly against the matrix.

Should the loading clamp be accidentally left in position at any particular station, the operating lever will contact the bar *F* as the fixture indexes, thus releasing the clamp and allowing the arm to swing freely. The angular position of the work-fixture is such that there is no tendency for the arm to ride up toward the cutter if the loading clamp is not engaged with a blade.

Details of Provisions for Clamping Work

A part-sectional view of the work-holding fixture, showing the clamping arrangements, is illustrated in Fig. 8. The work-pieces are held root-end downward, the tips engaging stops which are cut away to provide cutter clearance and allow the blade form to be milled over the full length. It may be noted that the engaging face of the tip stop *A* is slightly inclined to match the 85-degree step angle milled on the blade blank at the first machining operation. Any tendency for the blade to rise from the locating matrix at the tip end during milling is prevented by this arrangement.

The root end of the blade is engaged by a rectangular-headed turn-clamp *B*, which has a bore considerably larger than that of the stud which holds it in position, thus providing a large measure of freedom. In the position illustrated, the clamp applies pressure to the root end to hold the blade surface against the matrix, the curved lower face of the clamp bearing against a cam surface which extends around the base of the fixture, as indicated at *C*. The effect is to push the clamp upward against the end of the blade to insure that the tip stop *A* is properly engaged, and, at the same time, to apply pressure to the outer face of the root when the nut *D* is tightened.

A self-adjusting device is employed to support the root of the blade against the inward pressure of the clamp. On each clamp, a dog is provided which engages a dog on a cam member *E* having a lobe of the form indicated at *F*. Rotation of the clamp, therefore, rotates the cam, which, with the clamp in the loading position, engages the supporting pad *G*, and pushes it upward against the pressure of a spring.

After the blade to be milled has been positioned on its matrix by the auxiliary loading clamp, as already described, the clamp *B* is rotated and the cam lobe *F* releases the plunger carrying pad *G*. As the plunger axis is inclined slightly relative to the root face of the work-piece, the plunger descends until contact is made between the pad and the blade, whereupon it jams. The angle of inclination of the plunger is sufficiently small to prevent any tendency for it to be pushed upward due to the lateral pressure of the clamp. Hence, a solid support is provided, which, at the same time, is self-compensating for variations in the blade root form.

The helical cutter is supported by an auxiliary center at the lower end. It is made from high-speed steel containing 18 per cent tungsten and 5 per cent cobalt. The cutting speed is approximately 25 surface feet per minute. Best results on this operation have been obtained with Shell "Garia" cutting oil. While the cutter illustrated is of the right-hand cutting and right-hand spiral type, very good results have been obtained on similar milling operations by using cutters having a left-hand spiral but cutting right-hand.

The success of the latter type of cutter, which has negative rake at the corner radius, appears almost to contradict the general findings as regards the use of negative-rake milling cutters, which are not considered suitable for Nimonic. It is thought to result from the fact that the left-hand spiral tends to seat the cutter more firmly in its chuck. The general rigidity of the set-up is thus increased, whereas a right-hand spiral tends to pull the cutter from the chuck when the direction of rotation is right-hand.

The remaining operations performed in the machining of Nimonic blades will be described in a second article, to be published in a future issue of MACHINERY.

Functional Checking of Backlash in Gear Trains

By LOUIS D. MARTIN, Gear Engineer
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IN the article "Functional Checking of Gear Teeth," published in April, 1950, MACHINERY, page 208, attention was directed to the fact that when precise measurements of backlash in gears are required, methods of inspection that duplicate or closely approach final use of the gears should be employed. Since gears rotate on their axes and mesh with other gears, any method of checking the play between the teeth that ignores this fact is likely to lead to erroneous conclusions. Frequently, diverse methods for checking backlash in gears cannot be made to agree with each other. The disagreement is the result of the use of methods having definite limitations. More is expected of a checking device, often, than should be.

It is true that the man at the machine must be provided with some simple means of obtaining the size of a gear while it is still in the machine. He may employ a gear-tooth vernier, a set of measuring wires, or some other type of tooth thickness gage. In using these measuring devices, he checks either the tooth thickness or space width. At this point in the manufacture, it is justifiable to check gears for size in this manner. It is certainly better than relying entirely on the depth marked on the cutter or hob.

However, these measurements should be supplemented with the more reliable composite backlash check made by rotating the gear being checked in contact with a master of known accuracy and measuring their radial displacements. When gears are checked in this manner, they will come very close to their functional requirements.

The chart of a 32-pitch, 64-tooth master spur gear having a 14 1/2-degree pressure angle, which was made by running the master gear in contact with a Kodak master worm section on a "Conju-Gage," is seen in Fig. 1. A run-out of

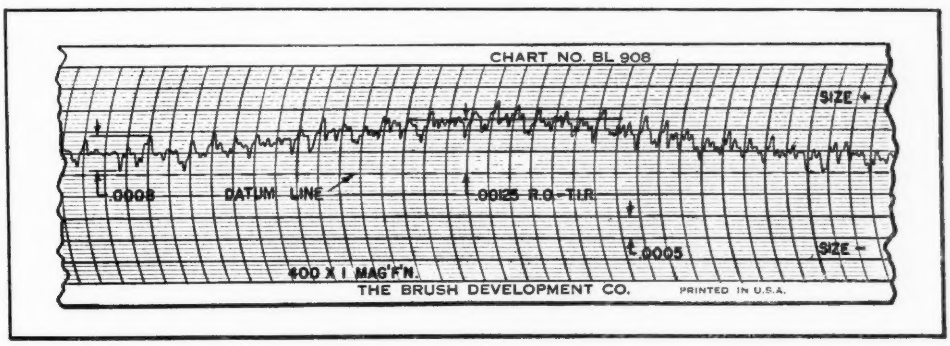


Fig. 1. Chart of a 32-pitch, 64-tooth master spur gear with a 14 1/2-degree pressure angle, made on a "Conju-Gage" at a magnification of 400

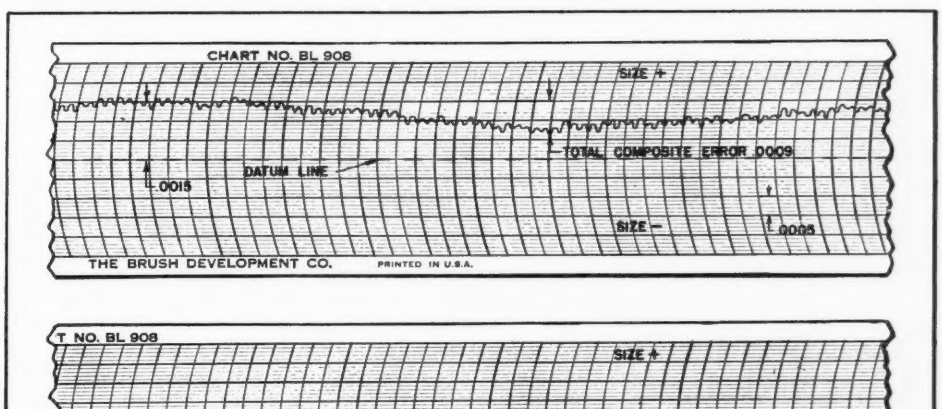


Fig. 2. Two charts of 32-pitch, 108-tooth gears having a 20-degree pressure angle. The top chart is for a hobbed gear, while the one at the bottom is for a shaved gear

0.00125 inch total indicator reading and a tooth-to-tooth composite error of 0.0008 inch are indicated on the chart. The datum line shows the nominal center distance setting between the master gear and worm section. It will be seen that the size of the gear radius is + 0.00125 inch at the high point of the run-out and + 0.0008 inch at the low point of the run-out, which occurs at the crest of the wave showing the tooth-to-tooth error. Yet this master checked — 0.00005 inch for size when measured by means of pins.

Fig. 2 shows two charts of 32-pitch, 20-degree pressure angle gears having 108 teeth. The chart at the top is for a gear hobbed 0.0015 inch over size on its pitch radius, as determined with a Kodak master worm section. Its total composite error is 0.0009 inch. Such a gear, as cut, falls within Precision Class I as defined by A.G.M.A. Standard 236-02. Pin measurements of this gear showed it to be 0.0008 inch smaller in diameter than that obtained by the composite check. This difference, admittedly, is small, except where exacting backlash requirements must be met.

When this gear was shaved, its total composite error was reduced to 0.0002 inch, as shown in the chart at the bottom of Fig. 2, and its tooth-to-tooth composite error was reduced to 0.0001 inch. Pin measurements of the shaved gear agreed perfectly with the composite backlash check. This demonstrates that only when there is practically no composite error in gear teeth will pin measurements agree with those made by means of a master. Backlash measurements of non-standard gears, made by checking their radial displacements, require special consideration.

The accompanying data sheets (Figs. 3 and 4) are used in determining the center distance correction required to insure engagement without backlash of gears having tooth thicknesses that are not standard. Their derivation is based on the well-known principle that a change in the tooth thickness of a gear (on the standard pitch diameter), expressed as the number of teeth divided by the diametral pitch, will result in a proportional change in the center distance of the gear when meshing with a standard rack. This produces what is termed the "apparent diameter" of the gear. Data Sheets Nos. 1A and 2A are enlargements of lower left-hand corners of Data Sheets Nos. 1 and 2, respectively. These charts are derived from the A.G.M.A. Standard 236.02.

The following notation applies to the formulas used in developing the data sheets:

P = diametral pitch;
N = number of teeth in gear;
n = number of teeth in pinion;
C = standard center distance;
C_1 = no-backlash center distance;
D = standard pitch diameter;
t = standard tooth thickness;
ϕ = standard pressure angle;
ϕ_1 = pressure angle at C_1;
$\triangle t$ = increase or decrease from standard tooth thickness;
$\triangle C$ = increase or decrease from standard center distance;
$\triangle D$ = increase or decrease from standard pitch diameter;
$\Sigma\triangle t$ = sum of increase or decrease from standard tooth thickness;
$\Sigma\triangle D$ = sum of increase or decrease from standard pitch diameter (over size or under size).

Formulas Used in Developing the Data Sheets

The formulas used in developing the sheets are as follows:

$$C = \frac{N + n}{2P}$$

$$\Sigma\triangle t = \Sigma\triangle D \tan \phi$$

$$\triangle \text{Inv } \phi = \frac{\Sigma\triangle t}{2C}$$

$$\text{Inv } \phi_1 = \text{Inv } \phi \pm \triangle \text{ Inv } \phi \begin{pmatrix} + \text{ for increased } \Sigma\triangle D \\ - \text{ for decreased } \Sigma\triangle D \end{pmatrix}$$

$$K = \frac{\text{Cos } \phi}{\text{Cos } \phi_1}$$

$$C_1 = K \times C$$

$$\triangle C = C_1 - C$$

$$D \text{ apparent} = D \pm \triangle D$$

To make the use of the charts clear, several examples will be given.

Example 1—

Pinion: $N = 20$; $P = 20$; $\phi = 20$ degrees;

$\triangle D = 0.045$ inch over size.

Gear: $N = 60$; $\triangle D = 0.005$ inch over size;

$\Sigma\triangle D = 0.045 + 0.005 = 0.050$ inch

$$C = \frac{20 + 60}{2 \times 20} = 2 \text{ inches}$$

Referring to the bottom abscissa of Data Sheet No. 1, 0.050 inch is located on the $\Sigma\triangle D$ scale. Continuing vertically on this line until it intersects the 2-inch center-distance curve, the point thus located is referred to the ordinate scale, which shows the required change in center distance to be 0.024 inch. Then, the no-backlash center distance $C_1 = 2 + 0.024 = 2.024$ inch.

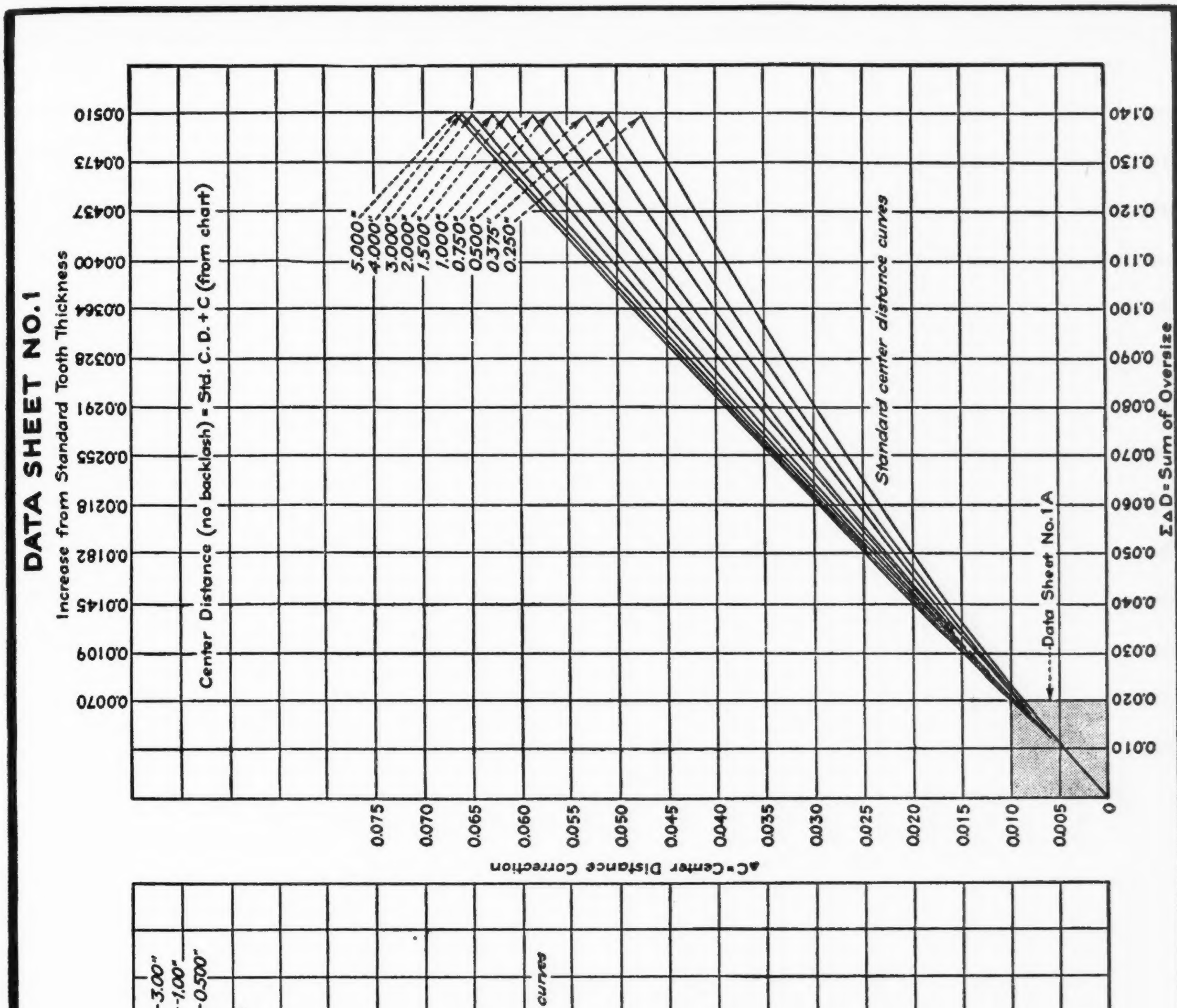


Fig. 3. Chart developed for finding change in center distance required to correct backlash in mating gears

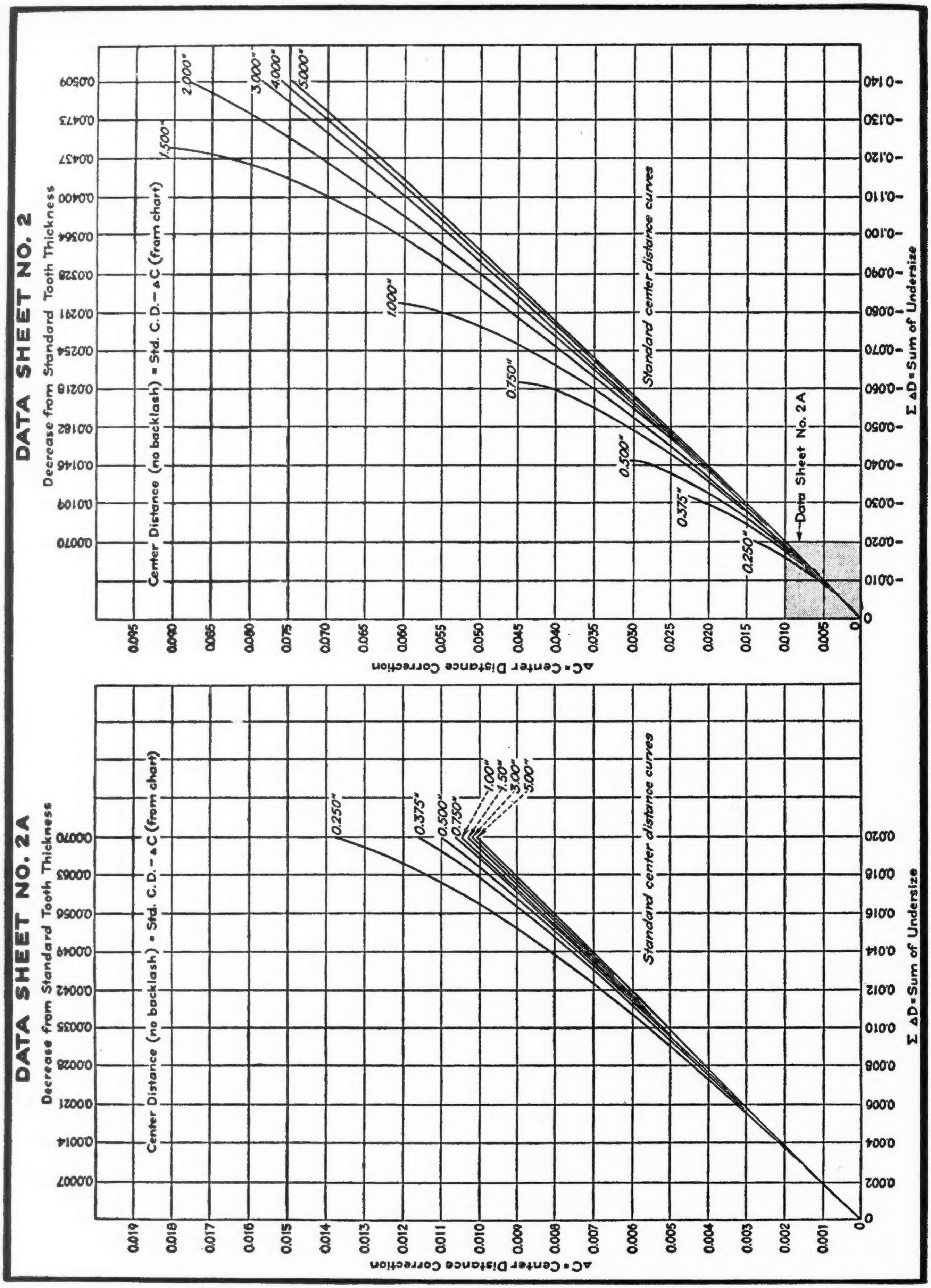


Fig. 4. Chart developed for finding change in center distance required to correct backlash in mating gears

Example 2—

Pinion: $N = 40$; $P = 80$; $\phi = 20$ degrees;

$\Delta t = 0.0055$ inch increase.

Gear: $N = 80$; $\Delta t = 0.0015$ inch increase;

$\Sigma\Delta t = 0.0055 + 0.0015 = 0.0070$ inch

$$C = \frac{40 + 80}{2 \times 80} = 0.750 \text{ inch}$$

Referring to the top abscissa of data sheet No. 1A, 0.0070 inch is located on the "Increase from Standard Tooth Thickness" scale. Continuing vertically downward on this line until it intersects the 0.750-inch standard center distance curve, the point thus located is referred to the ordinate scale, which shows the required change in center distance to be 0.0095 inch. Then the no-backlash center distance $C_1 = 0.750 + 0.0095 = 0.7595$ inch.

Example 3—

Pinion: $N = 40$; $P = 80$; $\phi = 20$ degrees;

$\Delta D = 0.015$ inch under size.

Gear: $N = 80$; $\Delta D = 0.005$ under size;

$\Sigma\Delta D = 0.015 + 0.005 = 0.020$ inch.

$$C = \frac{40 + 80}{2 \times 80} = 0.750 \text{ inch}$$

Referring to Data Sheet No. 2A and proceeding as in the other examples, the change in center distance will be found to be 0.0106 inch. Then the no-backlash center distance $C_1 = 0.750 - 0.0106 = 0.7394$ inch.

Functional checking of backlash mating gears takes into account all factors affecting play between them, and is the best assurance that the desired performance will be attained in their final mountings.

A.S.M.E. Semi-Annual Meeting in St. Louis

THE semi-annual meeting of the American Society of Mechanical Engineers, held at the Hotel Statler, St. Louis, Mo., June 19 to 23, covered a very wide range of subjects appealing to broad groups of the society's membership. The Production Engineering Division held three joint sessions with the Machine Design Division and one joint session with the Cutting Fluids and Metal Cutting Data Committees.

At one of these sessions, two highly informative papers were read, one on contour turning by K. T. Kuck, vice-president of engineering, Monarch Machine Tool Co., and the other on contour milling by M. E. Martellotti, research engineer with the Cincinnati Milling Machine Co. At another session a paper entitled "New High Accuracy Cam Contour Mill Design and Applications" was presented by A. D. Gunderson, tool engineer with the George Gorton Machine Co. Another paper, read by T. T. Woodson, engineer of the appliance and merchandising department of the General Electric Co., covered motor properties for integral design.

A comprehensive analysis of motor performance was presented by R. H. Schuman of the Warner & Swasey Co., and a paper on "The Stress Distribution in the Continuous Chip—a Solution of the Paradox of Chip Curl," was read by E. K. Henriksen, head of the materials processing department of the College of Engineering of Cornell University.

The effect of cutting fluids on chip and tool "interface" temperatures was discussed by the Cutting Fluids Committee. A joint paper on the subject was prepared by M. C. Shaw, associate professor of mechanical engineering at the Massachusetts Institute of Technology; J. D. Pigott, research engineer of the Draper Corporation; and L. P. Richardson, research engineer of the Shell Research & Development Co. Another paper, by Professor K. J. Prigger and B. T. Chao of the University of Illinois, entitled, "An Analytical Evaluation of Metal Cutting Temperatures" also was presented at the cutting fluids session. In addition, there were sessions on management, railroad engineering, aviation, gas turbine power, applied mechanics, steam power, boiler feed water, fuels, petroleum, and the process industries.

* * *

Official British and Canadian standards groups will receive shortly recommendations for bolt, nut, and cap-screw dimensions which, if adopted, will mean virtual unification with the American standard. Two series are to be recommended—bolts, nuts, and cap-screws for heavy-duty machinery, and a selection based, in all but one case, on present proposed American standards for either regular or light series. All of the great benefits of interchangeability deriving from the unification of screw threads which the three countries accomplished almost two years ago would be intensified if the recommended series are adopted by Britain and Canada.

American Gear Manufacturers Convene at Hot Springs

THE thirty-fourth annual meeting of the American Gear Manufacturers Association was held at the Homestead, Hot Springs, Va., June 5, 6, and 7. The meeting consisted of business sessions of the various technical, commercial, and engineering committees, and a technical session. Two outstanding papers were presented, as follows: "Heat-Treating Gears by Induction Heating," by John A. Redmond of the Westinghouse Electric Corporation; and "History of Power Transmission," by W. A. Williams of the American Pulley Co.

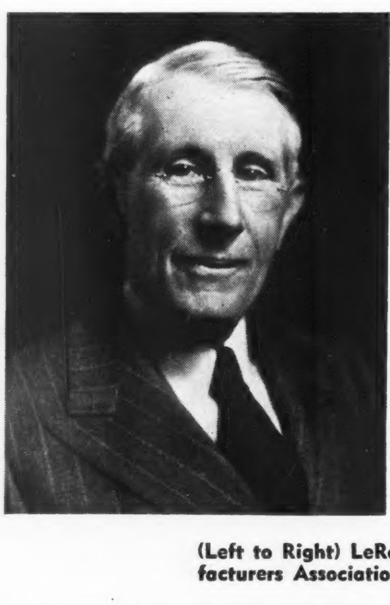
Mr. Redmond mentioned in his paper that induction heating has many inherent advantages in its application to gears, probably the greatest being the reduction of distortion. He pointed out that induction-hardened gears are usually made from S A E 1045 or 1050 steel. At present, there are two basic methods of hardening gears by this process. In the first method, the entire tooth and the steel in the rim of the gear at the base of the teeth are heated above the hardening temperature. In the second method, only a surface layer of the steel around the teeth is heated above the hardening temperature. In the "through" heating method, the teeth must be brought up to the hardening temperature without too much heating of the ring or web of the gear if the process is to be economical and distortion prevented. If the heating is too fast, the tips of the teeth will be overheated before the steel in the vicinity of the root is up to temperature. In general, a large tooth can be hardened at a low power density, while a small tooth can be hardened at a considerably higher power density. The results obtained by "through" heating methods depend upon the tooth size, the quench, and the pretreatment given the steel.

Mr. Redmond pointed out that there has recently been developed a two-frequency induction heating process for the surface hardening of gears. In surface-hardening small gear teeth, the heating time is usually less than a second. This requires a high power density at a relatively high frequency, say 200 to 400 kilocycles. A system of preheating gears by 10,000-cycle induction heating before application of the high power high frequency was developed to eliminate the unsatisfactory results obtained when preheating is not employed. Preheating the gear accomplishes the following:

1. Less high-frequency power is necessary to bring the surface of the gear tooth up to the hardening temperature, because the gear receives the high-frequency power after it has reached a temperature of 1100 degrees F. This is approximately a two-to-one saving in the high-frequency power necessary.

2. The heat stored in the steel near the root radius decreases the conduction losses in this area, making it easier to bring the steel in the root radius above the hardening temperature.

3. The steel throughout most of the tooth and root radius is placed in partial solution by pre-



(Left to Right) LeRoy Brooks, Jr., newly elected president of the American Gear Manufacturers Association; George H. McBride, vice-president; and Louis B. Bond, treasurer

heating. The gear tooth is preheated to 1400 or 1500 degrees F. and then allowed to cool to 1100 to 1200 degrees F. before the high-frequency power is applied. This decreases the solution time on the final heat application.

4. When gear teeth of 8 pitch and larger are preheated with 10,000-cycle current, the distribution of the current is such that the steel in the root radius gets hotter than the steel at the tips of the teeth. This is a decided advantage in obtaining a uniform temperature distribution around the contour of the teeth, the reverse effect being true with the radio-frequency power.

Mr. Williams, in his paper, pointed out that a careful study of available literature shows that toothed wheels, or gears, were the earliest form of continuous mechanical power transmission. There has been a popular misconception that belts and pulleys were used by the Egyptians and Babylonians for the transmission of power, but no one has been able to show that the ropes and pulleys used by the ancients for hoisting were adapted to the continuous transmission of rotary motion prior to 1200 A.D.

In the pre-Christian era, toothed wheels were in use as early as 330 B.C., according to the writings of the philosopher Aristotle, in which such wheels are mentioned as employed in windlasses. By 250 B.C., toothed wheels were in use in hydraulic organs and clocks. About this time, an advanced form of toothed wheel was the lantern pinion, which consisted of two disks with bars connecting them at their peripheries. The bars, forming the teeth which engaged projecting pins on a gear wheel, usually ran on an axis 90 degrees from the axis of the lantern pinion. This construction was used to drive a stone mill in Rome some time prior to 16 B.C.

All of the evidence points to the fact that power was first applied to the grinding of wheat and other grains, and was seldom used for any other purpose until more than one thousand years later. Several forms of water-driven mills have been recorded. The earliest form did not have gears, but utilized a water wheel that revolved on a vertical axis and was connected directly to the millstone. An illustration of this device, taken from the writings of Vitruvius, which appeared about 16 B.C., was shown. Another interesting illustration from the same source, but which also appears in the works of Hero of Alexandria about one hundred years earlier, showed an ingenious set of worm drives which operated from the axle of a stagecoach or wagon as a means of recording the distance traveled. The device was geared so that a day's journey usually resulted in one complete revolution of the hand on the dial at the top of the instrument.

Mr. Williams' paper traced the history of power transmission from these early days up to the end of the nineteenth century. His paper, which was a revision of one published in the July, 1949, issue of the "Journal of the Franklin Institute" of Philadelphia, Pa., ended by pointing out that we should recognize the fact that we have achieved our mechanical wonders because of the developments of our forefathers, who gave us a sound platform of achievement on which to build further.

LeRoy Brooks, Jr., president of the Tool Steel Gear & Pinion Co., Cincinnati, Ohio, was elected president of the American Gear Manufacturers Association for the current year. George H. McBride, sales manager of the Nuttall Works, Westinghouse Electric Corporation, Pittsburgh, Pa., was elected vice-president; and Louis B. Bond, vice-president and general manager of the Christiana Machine Co., a subsidiary of the Charles Bond Co., Philadelphia, Pa., was elected treasurer.

The following members were elected to the executive committee of A.G.M.A. to serve until June 30, 1953: J. Harper Jackson, sales manager of the Jackson Gear Co., Pittsburgh, Pa.; J. R. Mahan, director of engineering, National Supply Co., Toledo, Ohio; Fred R. Eberhardt, president of the Eberhardt-Denver Co., Denver, Colo.; and Walter W. Trout, president of the Lufkin Foundry & Machine Co., Lufkin, Tex.

* * *

Steel Founders' Society Sponsors Safety Competition

A national competition intended to promote safety practices in steel foundries is being sponsored by the Steel Founders' Society of America, Cleveland, Ohio. The contest, open to the more than 150 member foundries, was started in June and will continue through July and August—a quarterly period during which accident frequency rates are usually high.

Rules of the American Standards Association will be used to determine lost-time injury rates. Awards will be based on statistical results of monthly reports filed with the Society under rules and procedures formulated by its National Safety Committee. The winner in each of four groups will be presented with a permanent plaque, and a certificate of achievement will be given to each foundry having a lost-time accident frequency rate of 10 or less for the contest period.

This competition is conducted annually by the Society, the 1949 contest being marked by an all-time record low in the industry's cumulative lost-time injury frequency rating.

Important Points to Consider

By FRITZ ALBRECHT, Supervisor
Manufacturing Research and Development
The Glenn L. Martin Co., Baltimore, Md.

SPECIFIC applications of aluminum-alloy weldments in machine design have resulted in great advantages. A typical example is illustrated in Fig. 1, which shows a compression-loaded welded joint of heat-treated aluminum alloy. In general, however, the application of aluminum weldments has been restricted to cases where very high safety factors can be developed. This is due to a lack of knowledge of aluminum weld joint performance, which prevents the designer from taking advantage of the desirable qualities of such weldments. This article is intended to provide an outline of weldment characteristics as influenced by present methods and commonly available wrought alloys.

The joining of aluminum alloys by welding can be accomplished by several different methods. Aluminum alloys have properties that may vary widely when the material is welded as a result of the method used. It is therefore important to chose the particular method that will produce the quality of weld needed to meet the design requirements.

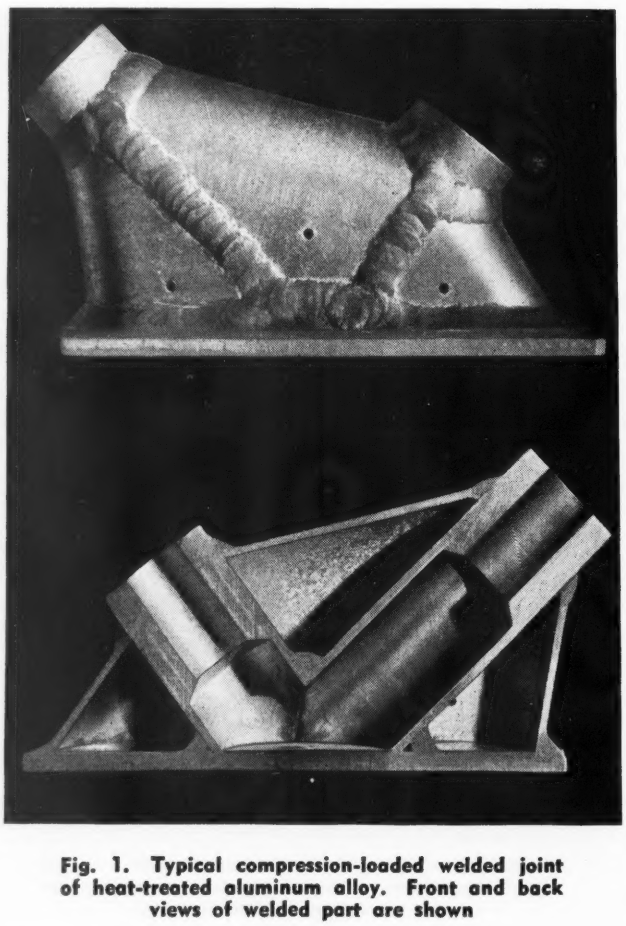


Fig. 1. Typical compression-loaded welded joint of heat-treated aluminum alloy. Front and back views of welded part are shown

Welds in the softer alloys can easily be produced so that ultimate tension failures will occur consistently in the parent material. With heat-treatable alloys when the weld is not machined, this is also true, although to a lesser degree. If, however, a heat-treated filler, usually parent material, is used and the weld is machined off flush, tension failures occur almost invariably in the weld metal. With this one exception, it can be said that the nature of the parent metal has a much greater influence on the final results than the filler material.

Selection of Filler Material

One type of filler material largely used is a 5 per cent silicon, 95 per cent aluminum alloy rod. This is employed for almost all work except where the highest possible chemical resistance or mechanical strength is required. For cases where chemical resistance is important, the less alloyed 2S or 3S type rod is used. In determining the rod to be used, it is necessary to consider not only the chemical to which the weldment will be exposed, but also the temperature and concentration of the chemical. In the case of very high mechanical requirements, strips of parent metal are generally used for filler. There is no alloy that is applicable to all cases and a careful check of the characteristics of the different alloys must be made before choosing a filler metal. Specific recommendations are beyond the scope of this article. The strength, ductility, and corrosion resistance of the joint vary according to the filler metal used.

Nature of Material to be Joined

The next element to consider is the material to be joined and its behavior, particularly as regards the influence of heat. Heat in welding is a necessary evil. Regardless of the source, or whether it is applied to parent metal or filler rod, metallurgical and mechanical deterioration of the heat-affected zone takes place. Aluminum alloys are similar to heat-treated high-alloy steels in that both react drastically to welding heat.

in Welding Aluminum

The reaction of aluminum alloys to weld heat is mainly as follows: (1) The strength produced by cold-working (rolling) is largely lost by welding, leaving a metal which is of low strength about the weld. (2) Where, in addition to rolling, high-strength materials have been heat-treated, the additional strength imparted by heat-treatment is destroyed in and about the weld. (3) A coarse, brittle structure is produced in the weld zone in all cases, as may be seen in Fig. 2.

The welding heat produces an annealed zone around the joint. The degree of annealing is constant in all welding methods, but the width of the annealed zone varies according to the method used, being smallest in the faster welding methods. When the design demands the highest attainable stability, the smallest annealed zone must be produced, and hence, only a very fast welding process will be satisfactory.

The loss of the cold-rolled properties cannot, practically, be repaired. The cast-metal nature of the weld cannot be modified. Thus, while tensile strength and corrosion resistance can be recovered, one-half the ductility, on an average, is lost.

Heat-treatment subsequent to welding, including quenching, is often employed to repair some of the damage done by welding. This makes the weldment suitable for service in such corrosive conditions as would not seriously harm the parent material. The designer, therefore, will do well when using high-strength alloys that are not heat-treated, to keep the weld from stressed areas under almost any condition. If corrosives are involved, this is absolutely essential.

Factors Affecting Welding Methods

Bearing in mind the preceding information on metal behavior, we are now ready to discuss welding methods. The following considerations must be taken into account:

1. Some means must be employed to protect the molten metal pool against oxidation and the absorption of gases, as in welding steel. This is accomplished by paste flux in gas welding, rod coating in arc-welding, and inert gas in inert-gas alternating-current arc-welding. In gas and arc welding, the flux also contributes toward higher fluidity and reduces the rate of chilling.

2. Contrary to steel-welding practice, neither the filler nor the flux is called upon to add anything to the weld in the nature of an alloying agent or replenisher of volatilized constituents.

3. A minor degree of deoxidation of the surface in alternating-current methods is effected by the cyclic "reversed polarity" period which reduces thin oxide films by electrolytic decomposition. However, the arc cannot remove the normal oxide resulting from storage and field conditions. This necessitates a thorough deoxidation prior to welding. The small amount of oxide which forms in a day or so can easily be reduced by the arc.

It is obvious, then, that for field welds where chemical cleaning is out of the question, designs permitting the use of flux and a torch or coated rod must be used. In either case, flux inclusions are likely. The continued chemical action of the flux, by itself or in the presence of corrosives, may result in cracking and eventual failure. Further, the presence of flux, inside or outside the weld, may greatly accelerate corrosion by otherwise essentially innocuous agents.

Thus, all welds of critical nature should be "shop welds," permitting the use of fluxless inert-gas-shielded alternating-current welding

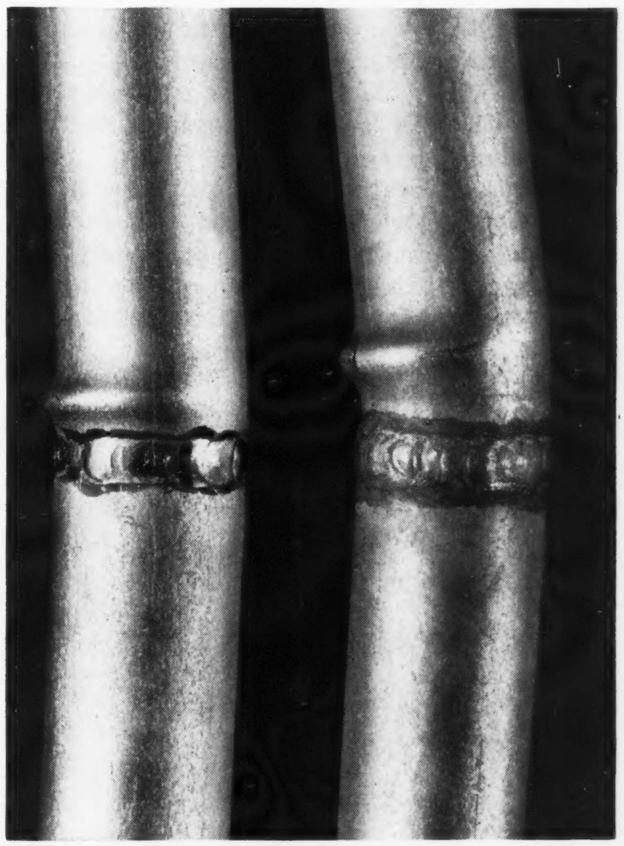


Fig. 2. Compression failures of welded joints. (Left) Shielded-arc welded joint subjected to an 18,750-pound load. (Right) Oxy-hydrogen-torch welded joint under a 14,500-pound load

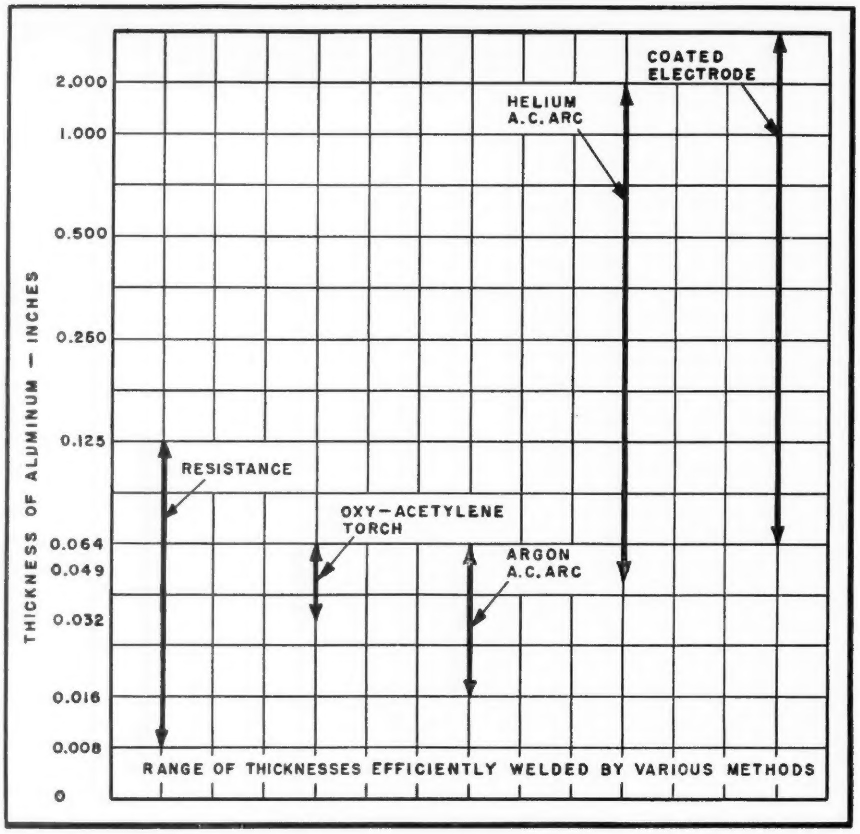


Fig. 3. Diagram showing the range of aluminum-sheet gages for which different types of welding methods are used

on chemically cleaned material. Less critical welds, where porosity, some flux inclusion with its attendant lower strength, and lower corrosion resistance and ductility can be tolerated, can be made in the field by the two more generally used methods—gas and covered-electrode arc welding.

Another consideration is what process is best suited for the gage to be welded. The range of gages most efficiently handled by the different methods is shown in Fig. 3. As referred to previously, a welding process must be selected which permits melting in a concentrated area with the least amount of excess heat, in order to avoid metallurgical changes. From a designer's point of view, another advantage is obtained by "quick welding." The low degree of warpage encountered, for instance, in the alternating-current arc makes it permissible to machine sub-assemblies and details to close tolerances with the assurance that little, if any, shifting of alignment due to warpage will take place. Because of the rapidity of the operation, spot-welding produces the smallest metallurgical and mechanical changes, and has the least extent of heat-affected zone, together with the greatest strength, especially in the heat-treated alloys.

In general, it is of the greatest advantage to select arc-welding methods when high strength is required. When, in addition to high strength, there must be no porosity and no inclusions, the shielded arc-weld methods are best. On the other hand, when field repairs on delicate, and perhaps heavily oxidized parts, are required, torch welding must be resorted to.

With aluminum welding, as with steel welding, systematic selection of welding procedure, welding rod composition, and alloy permits weldments to be made that fulfill design requirements previously considered attainable only in homogeneous structures, such as castings and forgings.

* * *

Swiss Toolmakers' Lathes Assembled by American Buyers

Components of Schaublin toolmakers' lathes built in Switzerland are now available from stock in the United States, enabling a buyer to assemble a precision lathe to meet his specific requirements. A variety of interchangeable headstocks, beds, carriages, tailstocks, special attachments, and controls are obtainable from the Hauser Machine Tool Corporation, 30 Park Ave., Manhasset, N. Y.

* * *

The United States now has steelmaking facilities capable of turning out nearly a hundred million tons a year.

Engineering News

High-Speed Reversal of Small Electric Motors

A method of reversing a small electric motor in three- to four-thousandths of a second has been developed by the National Bureau of Standards. Although designed to meet the need for high-speed reversal of magnetic tapes in electronic digital computing machines, the technique may prove useful in many other applications.

While it is relatively easy to stop a motor quickly by the use of brakes, rapid starts in either the same or the reverse direction are limited by the low torques obtained by electromagnetic means alone. Using a small, low-inertia, two-phase motor operating at 3200 R.P.M., the kinetic energy of the rotor, instead of being dissipated as heat in a brake during deceleration, is converted into potential energy in a spring, which is then used to accelerate the rotor rapidly in the opposite direction.

The reversal spring consists of a steel torsion bar, approximately 31 inches long and 3/16 inch in diameter. Only one phase of the motor is connected to the alternating-current power supply; thus the motor will rotate in the starting direction, either clockwise or counter-clockwise. The motor shaft is rigidly connected to one end of the torsion bar, which is equipped at the other end with two positive unidirectional clutches. One clutch prevents clockwise and the other counter-clockwise rotation.

If the motor is rotating in a clockwise direction and the proper clutch is engaged, the adjacent end of the torsion bar is thereby stopped; this brings the rotor to a stop in approximately 20 degrees. The potential energy stored in the torsion bar is then returned to the rotor in the form of a counter-clockwise impulse. The motor attains virtually full speed in the new direction within about two-thousandths of a second.

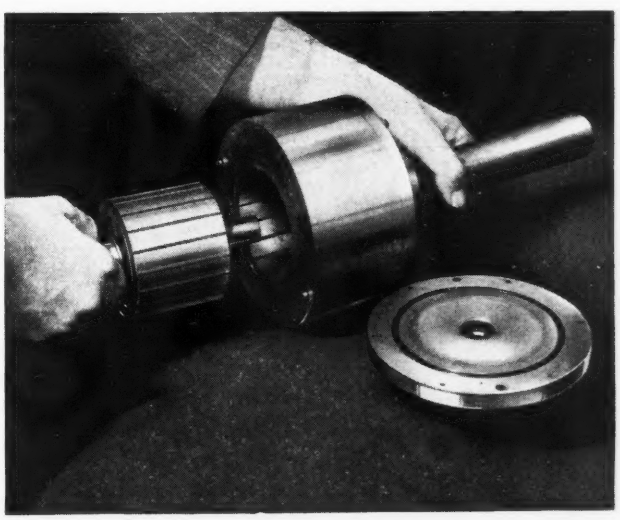
In the experimental model, the clutches are operated manually, but it is expected that in use they will be actuated by suitable electromagnetic controls. Although the tests thus far have used a small motor of about 1/75 H.P., it is anticipated that motors of all sizes could be reversed rapidly by this technique, the speed of reversal being limited only by the mechanical strength of the various parts. Moreover, by the use of suitably designed circuits, rapid reversal of motors can be obtained without producing large current surges in the electrical supply lines.

It would be feasible to utilize other types of energy-storing devices, such as coil springs or pneumatic cylinders, instead of the torsion shaft.

Clutch that Utilizes Magnetic Fluid in Its Operation

A liquid that can instantly change to a solid and then return to a liquid again is the basic feature of an improved magnetic-fluid clutch built by the General Electric Co. in the Engineering and Consulting Laboratory at Schenectady, N. Y. Though only 6 inches long and 6 inches in diameter, the device is able to carry enough power to lift one ton 1000 feet per minute. Consisting of two metal cylinders, each able to rotate independently on the same axis, the clutch transmits rotary power from its source to its load. The cylinders are separated by a magnetic mixture of oil and finely divided iron powder.

When the unit is energized, the fluid instantly solidifies, making a rigid connection between the two cylinders, so that as one cylinder revolves, its motion is transmitted to the other. Power can be applied to the load and removed from it easily by the clutch operator. Degrees of rigidity of the magnetic fluid can be obtained by regulating the current, so that the clutch can be allowed to slip if necessary. This clutch is still in the laboratory stage and commercial possibilities have not yet been explored.



Magnetic-fluid clutch that utilizes a liquid which can change instantly to a solid and then return to liquid form by regulation of electric current

Selection and Design of

Third in a Series of Articles Presenting Methods and Formulas Employed in Designing or Selecting Shaving Cutters for Gears. This Article Outlines the Step-by-Step Procedure for Selecting a Shaving Cutter for a Given Gear

THE problem of determining if a shaving cutter on hand is applicable to a gear having slightly different data than that for which the cutter was designed can be solved with the equations given in the first installment of this article (see May MACHINERY). The calculation procedure for this problem is similar to that used in designing a shaving cutter for a given gear (see second installment of this article, page 166, June number) except that in Steps (3) and (4) the calculations start with the cutter instead of the gear data. It is necessary to have complete data on the cutter and gear dimensions, as was required in designing a cutter.

As an example of this problem, the shaving diameter D_s, working depth h_k, and contact ratio m_p, produced by the cutter just designed on a different pinion are calculated. The data for the pinion and the mating gear are shown below. It will be noted that the pinion has the same normal circular pitch, normal pressure angle, and normal tooth thickness as one in the second article, for which a cutter was designed.

	Pinion	Mating Gear
Number of teeth	33	218
Diametral pitch	16.298701	....
Pitch diameter, inches....	2.025141	13.378204
Outside diameter, inches.	2.150	13.503
Addendum, inch	0.0625	....
Whole depth, inch	0.150	....
Helix angle	20°22′3.7″	....
Circular pitch, inch......	0.192793	....
Normal circular pitch, inch	0.180740	....
Normal pressure angle...	18°31′21.6″	....
Normal tooth thickness, inch	0.0870	....
Pressure angle	19°39′57.2″	....

The following assumptions and calculations are made:

Step 1

The pinion is hobbed with a pre-shave hob having a normal circular pitch corresponding to that of the pinion, and having a given distance from hob pitch line to protuberance high point.

The under-cut diameter D_u of the pinion may be calculated from Equations (10), (11), and (12) [see page 169, May number], substituting D_u for D. Given data: $\phi_p = 19$ degrees, 39 minutes, 57.2 seconds; $D_p = 2.025141$ inches; $h =$ —0.071807 inch. Then:

$$Y = -0.071807 + \frac{2.025141}{2} = 0.940764 \text{ inch} \quad (10)$$

$$X = \frac{-0.071807}{0.357380} = -0.200926 \text{ inch} \quad (12)$$

$$\left(\frac{D_u}{2}\right)^2 = (-0.200926)^2 + (0.940764)^2 \quad (11)$$

$$D_u = 1.923962 \text{ inches for the pinion}$$

The contact diameter D_c of the pinion is found by applying first Equation (13) to find X, using the gear data, and then Equation (12) to find h for the gear. The h dimension is then transferred to the pinion by reversing its sign. Equations (10), (11), and (12) are then applied to the pinion, substituting D_c for D.

Given data: D (gear) $= 13.503$ inches; D_p (gear) $= 13.378204$ inches; D_p (pinion) $=$ 2.025141 inches; and $\phi_p = 19$ degrees, 39 minutes, 57.2 seconds.

$$X = \frac{\sqrt{13.503^2\,(1+0.357380^2) - 13.378204^2} - 13.378204 \times 0.357380}{2\,(1 + 0.357380^2)} \quad (13)$$

$$X = 0.168696 \text{ inch}$$

$$h = 0.168696 \times 0.357380 = 0.060289 \text{ inch} \quad (12)$$

$$h = -0.060289 \text{ inch for pinion}$$

$$Y = -0.060289 + \frac{2.025141}{2} = 0.952282 \text{ inch for pinion} \quad (10)$$

$$X = \frac{-0.060289}{0.357380} = -0.168696 \text{ inch for pinion} \quad (12)$$

$$\left(\frac{D_c}{2}\right)^2 = (-0.168696)^2 + (0.952282)^2 \quad (11)$$

$$D_c = 1.934218 \text{ inches for pinion}$$

An excess form allowance of 0.004 inch is subtracted from D_c to give a form diameter for the pinion of $D_f = 1.930218$ inches. The amount of excess form allowance is based on experience and the class of gearing.

The axial pitch of the pinion is now calculated using Equation (3) for use in Step 3. Given

Gear-Generating Tools

By W. H. BOOKMILLER
Gear Engineering Division
General Electric Co.

data: $p_n = 0.180740$ inch and $\psi = 20$ degrees, 22 minutes, 3.7 seconds. Then:

$$p_x = \frac{0.180740}{0.348044} = 0.519302 \text{ inch for pinion} \qquad (3)$$

Step 2

It will be assumed that only the data that is stamped on the cutter or can be readily measured is known about the cutter. The stamping on the cutter gives the following information: $N = 157$ teeth; $p_n = 0.180740$ inch; $\phi_n = 18$ degrees, 31 minutes, 21.6 seconds; and $\psi = 13$ degrees.

The normal diametral pitch P_n is usually given in place of the normal circular pitch p_n. The relationship between these terms is as follows:

$$p_n = \frac{\pi}{P_n}$$

The outside diameter D_o of the cutter and the cutter tooth thickness t_n are required. The outside diameter is measured with micrometers. The tooth thickness is measured by the diameter-over-balls method. The results are: $D_o = 9.3660$ inches and $t_n = 0.0790$ inch.

These measurements place the cutter on the design curve in Fig. 6, with the cutter about half spent.

The circular pitch p_n, pitch diameter D_p, and pressure angle ϕ_t are calculated using Equations (1), (2), and (4). Given data: $p_n = 0.180740$ inch; $\phi_n = 18$ degrees, 31 minutes, 21.6 seconds; $\psi = 13$ degrees; and $N = 157$ teeth. Then:

$$p_t = \frac{0.180740}{0.974370} = 0.185494 \text{ inch for cutter} \qquad (2)$$

$$D_p = \frac{157 \times 0.185494}{3.141593} = 9.269997 \text{ inches for cutter} \qquad (1)$$

$$\text{Tan } \phi_t = \frac{0.335036}{0.974370} = 0.343848 \qquad (4)$$

$\phi_t = 18$ degrees, 58 minutes, 31.6 seconds for cutter

The transverse tooth thickness t of the cutter

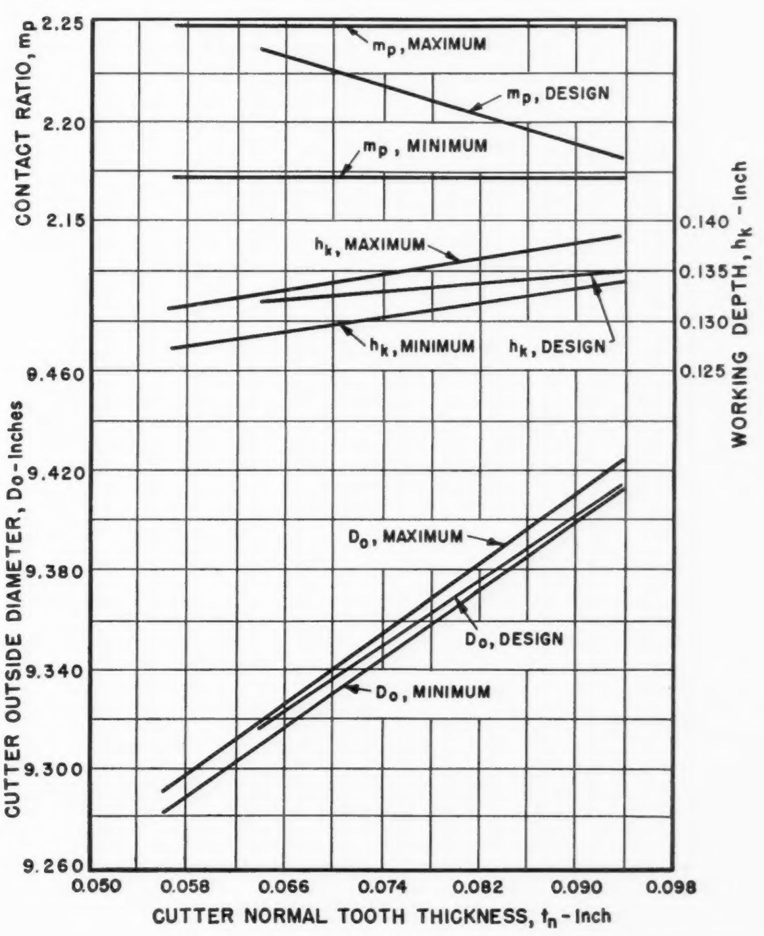


Fig. 6. Maximum and minimum cutter outside diameters, working depths, and contact ratios for a range of cutter normal tooth thicknesses

▼

is found from Equation (5). Given data: $t_n = 0.079$ inch and $\psi = 13$ degrees. Then

$$t = \frac{0.079}{0.974370} = 0.081078 \text{ inch} \quad (5)$$

Step 3

A series of rolling pressure angles ϕ_1 is assumed for the cutter. The values of ϕ_1 must cover a range extending above and below the actual rolling pressure angle. The values selected are based partly on experience and partly on trial and error when no previous calculations on the cutter are available. The calculations in Example 1 can be used as a guide in this example. The values of ϕ_1 selected are 18 degrees, 36 minutes, 18 degrees, 24 minutes, 18 degrees, 12 minutes, and 18 degrees.

In the calculations that follow, the procedure will be based on the use of $\phi_1 = 18$ degrees, 24 minutes. The calculations using other values of ϕ_1 are, of course, carried out in the same manner.

The rolling pitch diameter D_1, helix angle ψ_1, transverse tooth thickness t_1, and circular pitch p_{t1} of the cutter are calculated using Equations (6), (8), (7), and (9) for each assumed value of ϕ_1. Given data: $D_2 = 9.269997$ inches; $\phi_2 =$ 18 degrees, 58 minutes, 31.6 seconds; $\psi_2 = 13$ degrees; $t_2 = 0.081078$ inch; $p_{t2} = 0.192793$ inch; and $\phi_1 = 18$ degrees, 24 minutes.

$$\text{For } \phi_1 = 18°24', \frac{D_1}{D_2} = \frac{\cos\phi_2}{\cos\phi_1} = m = 0.996608$$

$$\theta = \text{inv. } \phi_2 - \text{inv. } \phi_1 = 0.001149$$

$$D_1 = 9.269997 \times 0.996608 = 9.238553 \text{ inch} \quad (7)$$

$$\text{Tan } \psi_1 = 0.996608 \times 0.230868 = 0.230085 \quad (6)$$

$$\psi_1 = 12 \text{ degrees, 57 minutes, 26.6 seconds}$$

$$t_1 = 0.996608\,(0.081078 + 9.269997 \times 0.001149) \quad (9)$$

$$t_1 = 0.091418 \text{ inch}$$

$$p_{t1} = 0.192793 \times 0.996608 = 0.184864 \text{ inch} \quad (8)$$

The normal circular pitch p_n, normal tooth thickness t_n, and normal pressure angle ϕ_n of the cutter are next calculated using Equations (2), (4), and (5). Rules (1) and (2) are then applied to this data to obtain the corresponding pinion data. Given data: $p_t = 0.184864$ inch; $t = 0.091418$ inch; $\phi_t = 18$ degrees, 24 minutes, and $\psi = 12$ degrees, 57 minutes, 26.6 seconds. Then:

$$p_n = 0.184864 \times 0.974537 = 0.180157 \text{ inch for cutter} \quad (2)$$

$$t_n = 0.091418 \times 0.974537 = 0.089090 \text{ inch for cutter} \quad (5)$$

$$\text{Tan } \phi_n = 0.332656 \times 0.974537 = 0.324186 \quad (4)$$

$$\phi_n = 17 \text{ deg., 57 min., 43.1 sec. for cutter}$$

Applying Rule 1 (see page 167, May number of MACHINERY), it will be found that the normal circular pitch for the pinion is 0.180157 inch, and the normal pressure angle for the pinion is 17 degrees, 57 minutes, 43.1 seconds. Applying Rule 2 and assuming that no extra cutting allowances are to be made, the normal tooth thickness of the pinion is equal to:

$$t_n = 0.180157 - 0.089090 = 0.091067 \text{ inch}$$

The pinion helix angle ψ is obtained by applying Rule (3) to Equation (3). The pinion circular pitch p_t, pressure angle ϕ_t, and tooth thickness t in the transverse plane can then be calculated using Equations (2), (4), and (5). The pinion rolling pitch diameters D_1 are obtained using Equation (1) and substituting D_1 for D. The m and θ values for the pinion that correspond to the cutter m and θ are also calculated. Given data: $p_x = 0.519302$ inch; $p_n = 0.180157$ inch; $t_n = 0.091067$ inch; $N = 33$; and $\phi_n = 17$ degrees, 57 minutes, 43.1 seconds.

According to Rule 3, p_x is constant for all values of D for a given pinion.

$$\text{Sin } \psi = \frac{0.180157}{0.519302} = 0.346921 \quad (3)$$

$\psi = 20$ degrees, 17 minutes, 56.71 seconds for pinion

$$p_t = \frac{0.180157}{0.937894} = 0.192086 \text{ inch for pinion} \quad (2)$$

$$t = \frac{0.091067}{0.937894} = 0.097097 \text{ inch for pinion} \quad (5)$$

$$D_1 = \frac{0.192086 \times 33}{3.141593} = 2.017714 \text{ inches for pinion} \quad (1)$$

$$\text{Tan } \phi_t = \frac{0.324186}{0.937894} = 0.345653 \quad (4)$$

$$\phi_t = 19 \text{ degrees, 4 minutes, 4.4 seconds}$$

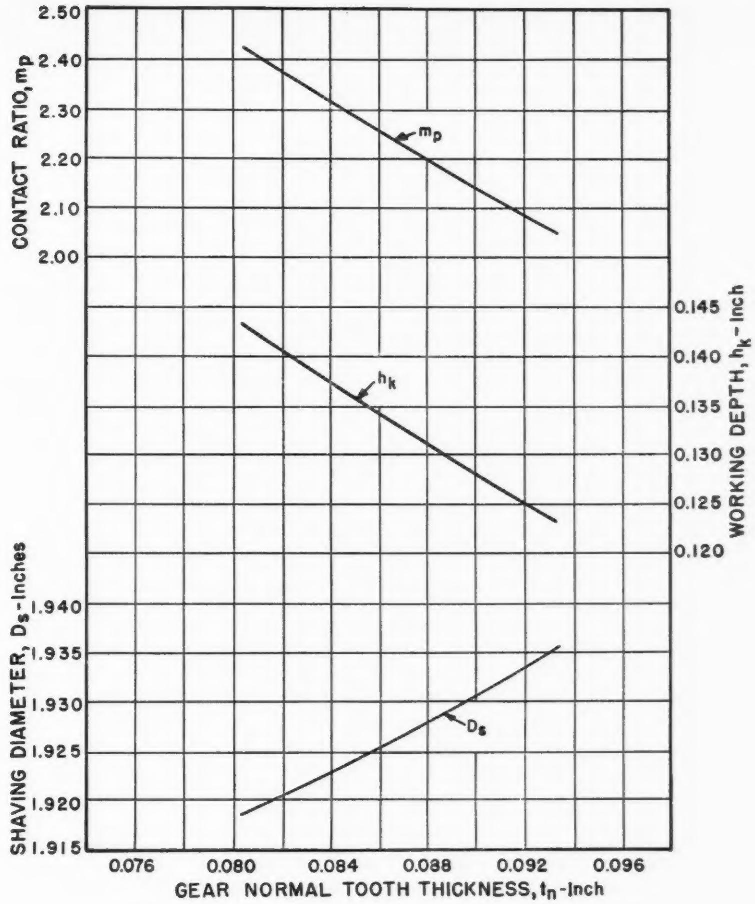
The values of m and θ for the pinion are calculated as follows: Given data: $\phi_1 = 19$ degrees, 4 minutes, 4.4 seconds; $\phi_2 = 19$ degrees, 39 minutes, 57.2 seconds; $D_1 = 2.017714$ inches; and $D_2 = 2.025141$ inches. Then:

$$m = \frac{D_1}{D_2} = \frac{2.017714}{2.025141} = 0.996332$$

$$\theta = \text{inv. } \phi_2 - \text{inv. } \phi_1 = 0.014146 - 0.012857$$
$$\theta = 0.001289$$

The transverse tooth thickness t_2 at the pinion pitch diameter is calculated using Equation (9). The normal tooth thickness t_n is then calculated using Equation (5). Given data: $t_1 = 0.097097$; $D_1 \div D_2 = 0.996332$; inv. ϕ_1 — inv. $\phi_2 = 0.001289$;

Fig. 7. Pinion shaving diameters, working depths, and contact ratios for various pinion normal tooth thicknesses



$D_2 = 2.025141$ inches; and $\psi = 20$ degrees, 22 minutes, 3.7 seconds. Then:

$$0.097097 = 0.996332\ (t_2 + 2.025141 \times 0.001289) \quad (9)$$

$$t_2 = 0.094844 \text{ inch}$$

$$t_n = 0.094844 \times 0.937478 \quad (5)$$

$$t_n = 0.088914 \text{ inch for pinion}$$

Step 4

The first step in calculating the shaving diameter D_s produced on the pinion by the cutter being used in this example is to apply Equations (12) and (13) to the cutter, using D_p and ϕ_p at the rolling conditions. The cutter outside diameter D_o is used for D. Given data: $D_o = 9.3660$ inches; $D_p = 9.238553$; and $\phi_p = 18$ degrees, 24 minutes. Then:

$$X = \frac{\sqrt{9.3660^2\ (1 + 0.332656^2) - 9.238553^2} - 9.238553 \times 0.332656}{2\ (1 + 0.332656^2)} \quad (13)$$

$$X = 0.181037 \text{ inch}$$

$$h = 0.181037 \times 0.332656 = 0.060223 \text{ inch for cutter} \quad (12)$$

The h coordinate is transferred to the pinion by reversing its sign. The pinion shaving diameter D_s is then calculated using Equations (10), (11), and (12). D_p and ϕ_p are taken for pinion rolling conditions. Given data: h (cutter) $= 0.060223$ inch; ϕ_p (pinion) $= 19$ degrees, 4 minutes, 4.4 seconds; and D_p (pinion) $= 2.017714$ inches.

$$h = -0.060223 \text{ inch for pinion}$$

$$X = \frac{-0.060223}{0.345653} = -0.174230 \text{ inch for pinion} \quad (12)$$

$$Y = -0.060223 + \frac{2.017714}{2} = 0.948634 \text{ inch for pinion} \quad (10)$$

$$\left(\frac{D_s}{2}\right)^2 = (-0.174230)^2 + (0.948634)^2 \quad (11)$$

$$D_s = 1.929002 \text{ inches for pinion}$$

Step 5

The working depth h_k for the various rolling pressure angles is calculated using Equation (14). Given data: $d_o = 9.3660$ inches; $d_1 = 9.238553$ inches; $D_o = 2.1500$ inches; and $D_1 = 2.017714$ inches.

$$h_k = 1/2\ [(9.3660 - 9.238553) + (2.1500 - 2.017714)] \quad (14)$$

$$h_k = 0.129867 \text{ inch}$$

The contact ratios m_p are calculated from Equation (15) after calculating X_G and X_C using

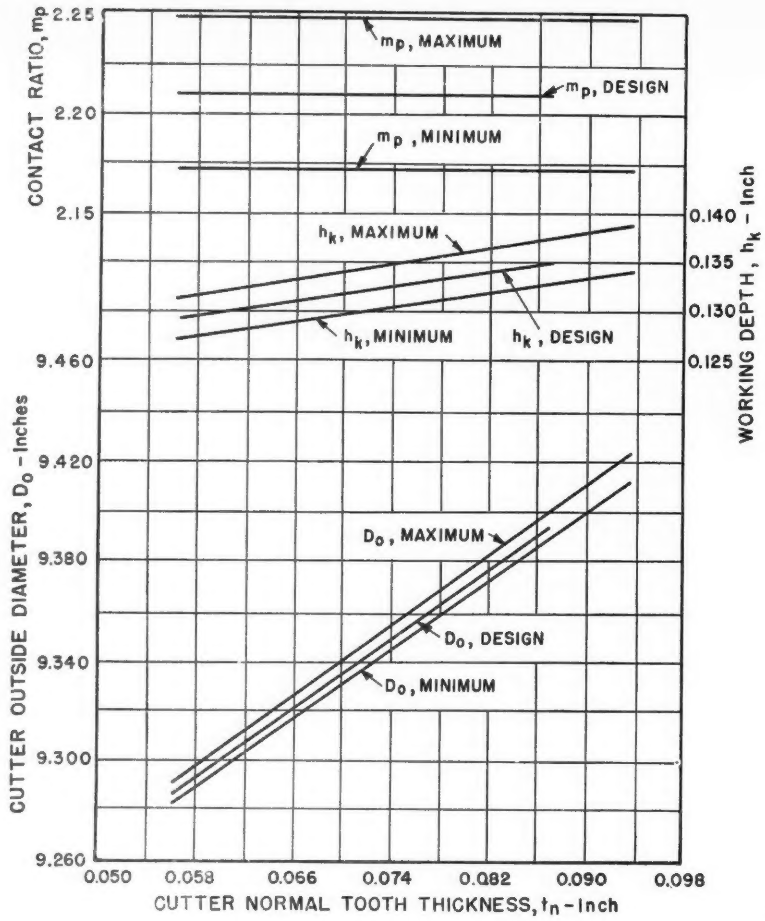


Fig. 8. Maximum and minimum cutter outside diameters, working depths, and contact ratios for various cutter normal tooth thicknesses. Limits are the same as in Fig. 6, but design curves have been relocated

Equation (13). All terms are taken at the rolling conditions. Given data: D (pinion) $=$ 2.1500 inches; D_p (pinion) $=$ 2.017714 inches; ϕ_r (pinion) $=$ 19 degrees, 4 minutes, 4.4 seconds; ψ_G (pinion) $=$ 20 degrees, 17 minutes, 56.7 seconds; D (cutter) $=$ 9.3660 inches; D_p (cutter) $=$ 9.238553 inches; ϕ_p (cutter) $=$ 18 degrees, 24 minutes; ψ_C (cutter) $=$ 12 degrees, 57 minutes, 26.6 seconds; $\phi_n =$ 17 degrees, 57 minutes, 43.1 seconds; and $p_n =$ 0.180157 inch.

$$X_G = \frac{\sqrt{2.1500^2\,(1+0.345653^2) - 2.017714^2} - 2.017714 \times 0.345653}{2\,(1+0.345653^2)} \qquad (13)$$

$$X_G = 0.157707 \text{ inch}$$

$$X_C = \frac{\sqrt{9.3660^2\,(1+0.332656^2) - 9.238553^2} - 9.238553 \times 0.332656}{2\,(1+0.332656^2)} \qquad (13)$$

$$X_C = 0.181037 \text{ inch}$$

$$m_p = \frac{\dfrac{0.157707}{0.937893} + \dfrac{0.181037}{0.974537}}{0.180157\,(0.951261)^2} \qquad (15)$$

$$m_p = 2.170947$$

It is not necessary to repeat Steps (4) and (5) as was done in the first example (June article), since we are considering only one outside diameter of cutter. The results of these calculations are tabulated as follows and plotted in Fig. 7.

ϕ_1	t_n, inch	D_s, inches	h_k, inch	m_p (contact ratio)
18°36′	0.0933	1.9355	0.1232	2.045
18°24′	0.0889	1.9290	0.1299	2.171
18°12′	0.0846	1.9233	0.1364	2.296
18°0′	0.0805	1.9185	0.1430	2.421

Fig. 7 gives the values of shaving diameter D_s, working depth h_k, and contact ratio m_p for several gear tooth thicknesses larger and smaller than the specified tooth thickness. These are:

t_n, inch	D_s, inches	h_k, inch	m_p (contact ratio)
0.089	1.9294	0.1298	2.168
0.088	1.9281	0.1313	2.197
0.087	1.9267	0.1328	2.226
0.086	1.9253	0.1343	2.255
0.085	1.9240	0.1358	2.284

It will be remembered that the shaving diameter should be more than the under-cut diameter, but less than the form diameter. Comparison of these shaving diameters D_s with the under-cut diameter D_u of 1.923962 inches and the form diameter D_f of 1.930218 inches, previously calculated for the pinion, and the working depth h_k of 0.135 inch with the maximum used in the previous example reveals that the cutter will be satisfactory for the specified tooth thickness of 0.087 inch.

The cutter will shave to the under-cut diameter when the gear tooth thickness is 0.085 inch,

and close to the form diameter when the gear tooth thickness is 0.089 inch. The maximum of 0.135 inch for h_k will be exceeded when the gear tooth thickness is 0.085 inch, but is less for the other thicknesses. This calculation indicates that a suitable range in gear tooth thickness would be 0.088 to 0.086 inch.

Discussion of Previous Problems Illustrating Design and Selection of Shaving Cutters

It will be recalled that the design curves in Fig. 6 were located so that the outside diameter of a new cutter would be near the allowable minimum and for a used or worn out cutter would be near the allowable maximum. For the problem discussed in this installment, a cutter was selected having a normal tooth thickness of 0.079 inch and an outside diameter of 9.366 inches. This point is on the D_o design curve in Fig. 6, and is approximately midway between the maximum and minimum outside diameter points for that tooth thickness; hence the shaving diameter at 0.087 inch pinion tooth thickness, for which the cutter was designed, is approximately midway between the pinion form and under-cut diameters.

As can be seen from Fig. 6, a new cutter has an outside diameter near the minimum. It will be remembered that the minimum cutter outside diameter curve in this chart is based on a pinion shaving diameter equal to the pinion form diameter. Thus, a new cutter will produce a shaving diameter on the pinion near the form diameter when the pinion tooth thickness is 0.087 inch. The tolerance on pinion tooth thickness should then be minus only, since the shaving diameter is near its maximum value.

However, if the maximum working depth h_k of 0.135 inch is to be maintained, the pinion tooth thickness cannot be reduced, since a new cutter is designed for a working depth $h_k = 0.135$ inch at a pinion tooth thickness of 0.087 inch. It is probably safe to allow a small increase in the working depth so that the gear tooth thickness may have a tolerance.

The chart also shows that a worn out cutter has an outside diameter near the maximum. This will produce a shaving diameter on the pinion near the under-cut diameter when the pinion tooth thickness is 0.087 inch. The tolerance on gear tooth thickness should then be plus only, since the shaving diameter is near its minimum value. Then the maximum value of working depth h_k will probably not be exceeded.

It is now apparent that the location of the design curves in Fig. 6 would be considered poor in many cases. In order to provide for a gear tooth thickness tolerance of, say, 0.002 inch that is minus for a new cutter and plus for a worn out cutter, it will be necessary to allow for a total possible variation in gear tooth thickness of 0.004 inch during the life of the cutter. If the outside diameter design curve is redrawn so that it is midway between the maximum and minimum diameter curves, the shaving diameter will remain approximately constant during the life of the cutter.

Fig. 8 is a duplicate of Fig. 6 except that the design curves are now drawn so that the shaving diameter will remain relatively constant. Since the working depth is still limited to 0.135 inch, the maximum cutter tooth thickness is 0.087 inch. A new cutter will have this tooth thickness and an outside diameter of 9.394 inches. The worn out cutter will have a tooth thickness of 0.057 inch and an outside diameter of 9.288 inches. A cutter of this design will never roll at its nominal pressure angle. Since the shaving diameter will remain approximately constant during the life of the cutter for a given gear tooth thickness, the cutter design represented in Fig. 8 will generally be more desirable than that indicated in Fig. 6. The gear tooth thickness range can remain at 0.088 to 0.086 inch during the life of the cutter.

Thus another limitation is added—that of locating the design curve so that the same gear-tooth thickness range may be used during the entire life of the cutter.

Application of Methods to Other Types of Cutters

The methods used in applying Equations (1) to (15) to the problem of designing a shaving cutter and the use of the cutter on a gear having slightly different data are applicable, with minor changes, to shaper cutters and hobs, which are special cases of the shaving cutter. It was pointed out early in this article that shaving cutters were essentially gears; hence many problems concerning the meshing of gears can also be solved by the methods outlined in these articles.

Shaper cutters will roll at various pressure angles during their life, just like shaving cutters. The gear and cutter will roll at the same pressure angles. A protuberance type cutter requires all the steps used for the shaving cutter design, except, probably, Step 6. Step 4 will give the diameter required at the protuberance high point instead of the outside diameter. Step 5 is used to get the outside diameter by assuming the working depth h_k is equal to the whole depth and is constant during the useful life of the cutter. The location of topping bevels and other gear

tooth modifications can be determined in a similar manner. Conventional roughing and finishing cutters will generally require only Steps 2, 3, and 5.

Hobs can be considered as racks, in order to simplify the calculations required. For a given hob and gear, the rolling pressure angles will be equal and constant as the hob is sharpened or "sunk in" or "held out." The gear rolling pitch diameter is constant under these conditions, but the gear tooth thickness will vary.

The location of the protuberance high point on hobs can be easily determined from Equations (12) and (13). The location of this point is usually given as a distance from the hob pitch line or tip. The distance h is measured from the rolling pitch line of the hob. The location of topping bevels can be found in a similar manner.

Certain phases of the calculations, such as those involving Equations (12) and (13), can be set up for graphical solution. The graphical method of solving these two equations is illustrated in "Graphical Determination of Contact Ratios," by D. W. Dudley in the March, 1948, issue of *Product Engineering*. Obviously, graphical solutions are not so accurate as calculated solutions, but they are sometimes accurate enough. Graphical solutions should be avoided when diameters near the base diameter are involved.

The methods of solving generating tool problems outlined in these articles do not involve complicated mathematics, but their solution sometimes requires extensive calculations. The calculations required can be set up on printed form sheets, so that a trained calculator, when provided with the basic data and rules of procedure, will be able to follow through the entire calculation and present the answers in an appropriate manner.

MAPI Holds Meetings to Promote Adoption of Equipment Replacement Formula

THE Machinery and Allied Products Institute is holding a series of meetings in principal cities to foster the practical application by industry of the Institute's recommendations on scientific replacement of worn-out or obsolete machines. One of these meetings was held May 23 at the Waldorf-Astoria, New York City, under the chairmanship of William J. Kelly, president of the Institute.

Duncan J. Stewart, vice-president of the Barber-Colman Co., Rockford, Ill., described the application of the MAPI formula in his own company. He emphasized the costliness of continuing to use machinery that should be replaced. In his company, a small staff of analysts is charged with the responsibility of keeping the management informed on needed replacements. It is the duty of this staff not only to know the performance of present equipment, but also to be familiar with the best available alternative at all times.

George Terborgh, research director of the Institute, discussed the theory behind the MAPI formula, and said that industry's current replacement policies are based on folklore rather than science. A case example was presented in detail by Everett M. Hicks, assistant manager, Grinding Machine Division of the Norton Co., Worcester, Mass. It was proposed to replace two ten-year old grinding machines with one modern grinder. The analysis covered such factors as interest, taxes, salvage value of the old machine, labor cost that could be saved by the new machine, and saving in floor space, power, and the like.

A basic objective of the procedure was to determine which would be more profitable to the owner during the next year—the two machines now in operation or the best available replacement. Mr. Hicks explained that engineers in any company can quickly be trained to apply the MAPI formula, and thereby determine when a machine is economically dead and due for replacement for economy of production.

* * *

SKF Workers Complete Industrial Courses

An industrial education program of eight months' duration, comprising eleven courses, which was organized by S K F Industries, Inc., Philadelphia, Pa., ended successfully with "commencement" exercises on June 8 for 222 nonsupervisory employes. The courses were given after work hours by skilled instructors, who were also company employes, and included such subjects as time and motion study, quality control, blueprint reading, production planning and control, mathematics, and materials-handling.

Metal Cutting in the World's Largest Aluminum Sheet and Plate Mill

ONE of the major developments of the Aluminum Co. of America is the world's largest aluminum sheet and plate rolling mill, which was recently constructed at Davenport, Iowa. This plant, which occupies approximately 400 acres of land, produces aluminum sheets in much larger coils than have been heretofore continuously strip-rolled, and turns out aluminum plate in larger sizes than any other mill.

Two large machine tools in this mill are seen in the accompanying illustrations. Fig. 1 shows an Ingersoll milling machine used for scalping the rough cast ingots so as to cut away the uneven surfaces and produce the smooth finish necessary for satisfactory rolling of sheets or plates. Surface irregularities are thus eliminated from the finished products.

Multiple sawing of aluminum plates is performed by the huge machine shown in Fig. 2. Sheets or plates can be stacked to a thickness of 6 inches, and can be handled in lengths up to 50 feet on this machine.

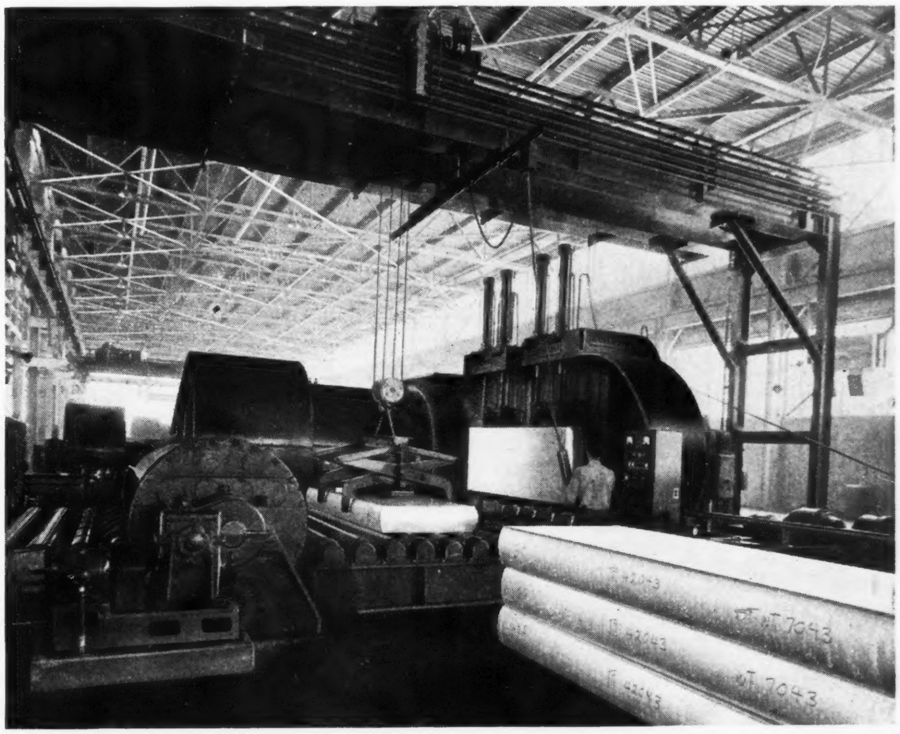


Fig. 1. Huge milling machine employed for cutting away the uneven surfaces of cast aluminum ingots so as to obtain the smooth finish required for sheet or plate rolling

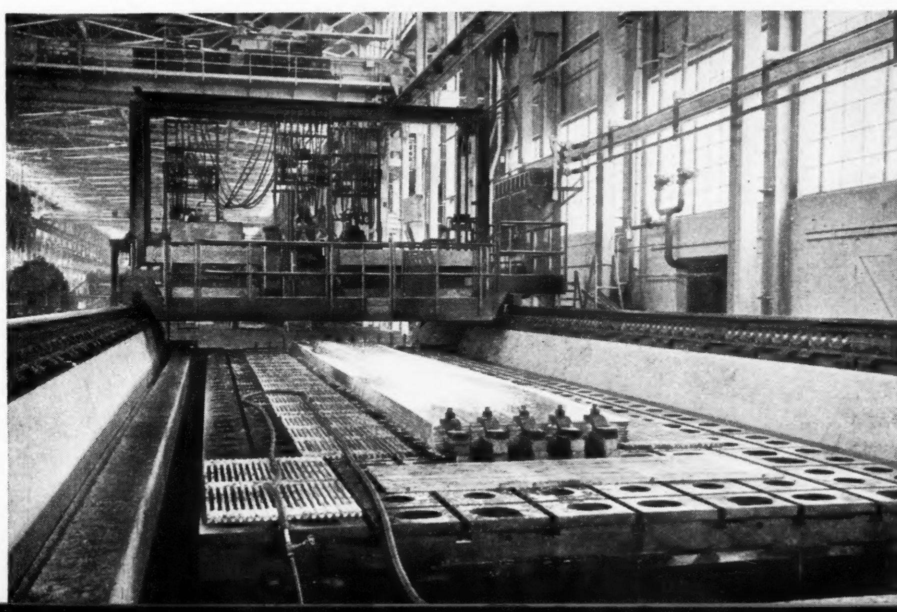


Fig. 2. Aluminum sheets or plates stacked to a thickness of 6 inches and up to 50 feet in length are multiple-sawed by this large machine, which is built with a stationary bed and a traveling rail on which the saws are mounted

Materials of Industry

THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

New Hard-Facing Alloy that Forms Abrasion-Resistant Surface

Aircolite 59, a new hard-facing alloy, has recently been developed by Air Reduction Sales Co., 60 E. 42nd St., New York 17, N. Y., primarily for applications involving high-stress abrasion with medium impact. The alloy has been on field trial for more than a year.

It is composed principally of chromium, molybdenum, carbon, and iron, and is cast in rod form. This hard-facing material has a low coefficient of friction, and acquires a high polish in service. It maintains its high hardness at temperatures up to 800 degrees F. The alloy, in bare form for oxy-acetylene application or coated for electric application, is suitable for use in steel mills, foundries, and metal-working plants. M-201

Chromium-Plated Steel Rods that Can be Bent, Formed, or Welded

A new type of chromium-plated steel rod having a bright, corrosion-resistant finish that can be bent, formed, spot-welded, butt-welded or swaged without damage to the chromium-plated surface is a recent product of the Kenmore Metals Corporation, 380 Ninth St., Jersey City 2, N. J. These rods are suitable for the manufacture of parts for furniture, bicycles, typewriters, refrigerators, racks, and many other formed-rod applications. Kenmore chromium-plated rods are available in diameters from No. 11 American wire gage to 5/16 inch, and in all commercial lengths. M-202

Physical Properties of New J & L Screw Steel

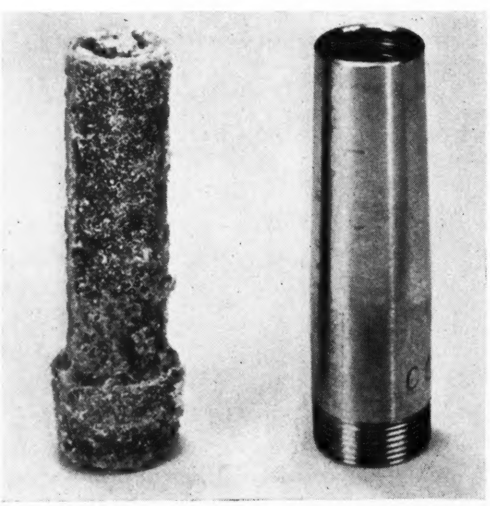
Jones & Laughlin Steel Corporation, Pittsburgh 30, Pa., has recently released information on the physical properties of the company's "E" steels, which are particularly suited for screw machine work. These steels, announced in May, 1949, MACHINERY, have the following machinability ratings, based on Bessemer screw steel B-1112 as 100:

Per Cent Relative Cutting Speed

"E" Steels	Conventional Steels
E-15, 110	B-1111, 90
E-23, 125	B-1112, 100
E-33, 170	B-1113, 135

The normal range of physical properties of E-33 steel (1-inch diameter round stock) is as follows:

	Hot-Rolled	Cold-Rolled
Yield point, psi.	33,000-43,000	73,000-76,000
Tensile strength, psi.	59,000-67,000	73,000-85,000
Elongation in 2 inches, %	27-38	10-20
Reduction of area, %	50-60	40-50



Nozzles made from a standard 18-8 stainless steel, used for production-line filling of batteries, were highly corroded in two weeks from handling 12 per cent sulphuric acid at 70 to 130 degrees F., as shown at the left. To overcome this difficulty, the nozzles were made from a new material, Carpenter Stainless Steel No. 20. These nozzles have been in use for many months in the plant of the Bowers Battery Mfg. Co. and show no evidence of corrosion. Their condition after this period of use is shown at the right

To obtain additional information about materials described here, use Inquiry Card on page 215.

The comparative machining performance for E-33 steel is eight to fifteen hours tool life, as compared with two to four hours for B-1113 steel. In addition to its excellent machining characteristics, the cold-forming properties of "E" steel have made possible the elimination of certain annealing operations in some plants........M-203

Cold-Spray Liquid Cleaner for General Maintenance

The E. I. du Pont de Nemours & Co., Wilmington, Del., has announced a new cleaning mixture designated No. 49, which is suitable for use on machines, electric motors and generators, and for maintenance work in general. It is said to dissolve grease rapidly and evaporate quickly. In addition, it is practically inert to ordinary electrical insulating materials, has low flammability and mild toxicity, and is easily handled...M-204

Castings of Improved Quality Obtained with New Core-Binder Resin

The development of a new synthetic thermosetting resin, Resinox No. 4846, for use as a core sand binder has been announced by the Monsanto Chemical Co., St. Louis 4, Mo. This resin is a rapid-curing phenolic of high bond strength and low cost, designed to meet the requirements of the foundry industry. Its use is said to result in cleaner castings, with better surface finish, greater detail, and less tendency toward veining, scabbing, and spalling.

A wide range of core properties obtainable by varying the core composition includes high tensile strength, high baked permeability, resistance to abrasion, and dimensional stability.....M-205

Fast Drying Metal Enamel that Requires No Baking

A fast drying enamel has recently been introduced on the market by the United Lacquer Mfg. Corporation, Linden, N. J. The new synthetic protective coating, known as Base Y2054, is said to provide the hardness of a baked-on synthetic, but dries in air as fast as lacquer. It produces a hard, resistant surface. Products finished with it can be handled and stacked within fifteen minutes and packed in three to four hours.

This enamel has high resistance to alkalies, fats, grease, and smoke, and is equally effective on wood, metal, or fiber products. It can be polished to a glossy finish, and retains its color under humid conditions. M-206

Single-Operation Pre-Paint Cleaner Removes Rust and Oil

Rust, oil, scale, etc., can be removed from metal surfaces prior to painting by a new cleaning material known as Oakite Compound No. 33, developed by Oakite Products, Inc., New York City. This material is effective in removing stamping and forming oils, rust preventives, carbon smuts, soldering and welding fluxes, identification inks, etc. The new cleaner is said to contain acid ingredients that act on rust, heat scale, tarnish, and other oxides. It has the ability to convert the surface layer of metal into a thin film of insoluble phosphates which provides an excellent bond for paint. Application may be by soak tank or hand swabbing methods. M-207

Mineral-Filled Compound for Molding around Inserts

A mineral-filled phenolic molding compound, Durez 14893 Black, possessing heat resistance, good finish, fast cure, and a relatively low specific gravity has been announced by Durez Plastics & Chemicals, Inc., North Tonawanda, N. Y. This compound can be molded either by the compression or plunger method. Its high-frequency preheating characteristics are similar to those of other mineral-filled materials, while its fast cure results in molding economies. The new compound is suitable for molding around inserts and for applications where prolonged high temperatures are encountered. M-208

New Plastic Produces Tough, Lasting Machine Components

Development of a tough, new plastic called "Enrup" has been announced by the United States Rubber Co., Rockefeller Center, New York 20, N. Y. This plastic is said to meet the need for a high-strength material that is resistant to abrasion and chemicals, and at the same time, can be produced in varying degrees of flexibility, ranging from elastic soft rubber to brittle hard rubber.

One of its uses is in the manufacture of high-strength, low-cost gears to replace metal gears in such applications as heavy-duty lathes, household appliances, plating barrels, automotive timing devices, and dynamometers. Gears made of the new plastic have been operating for more than a year in applications where conventional metal gears have failed within a few weeks. These gears were molded in one piece to very close tolerances, which eliminated the need for elaborate finishing operations. M-209

To obtain additional information about materials described here, use Inquiry Card on page 215.

Norton Grinding Machine Division Celebrates Fiftieth Anniversary

THIS year marks the fiftieth anniversary of the Norton Co.'s Grinding Machine Division. Upon incorporation, the grinding machine business was named Norton Grinding Co. (an independent enterprise whose parent was the Norton Emery Wheel Co.) and was established to manufacture the first production-precision cylindrical grinding machine in the United States.

In consequence, work began fifty years ago this spring on Norton plain machines for cylindrical grinding. The first machine was sold to R. H. Hoe & Co., of New York, for grinding printing press rolls. This machine was in continuous operation for twenty-seven years, after which the Norton Co. repurchased the machine and presented it to the Edison Institute of Technology at Dearborn, Mich., where it is on exhibit.

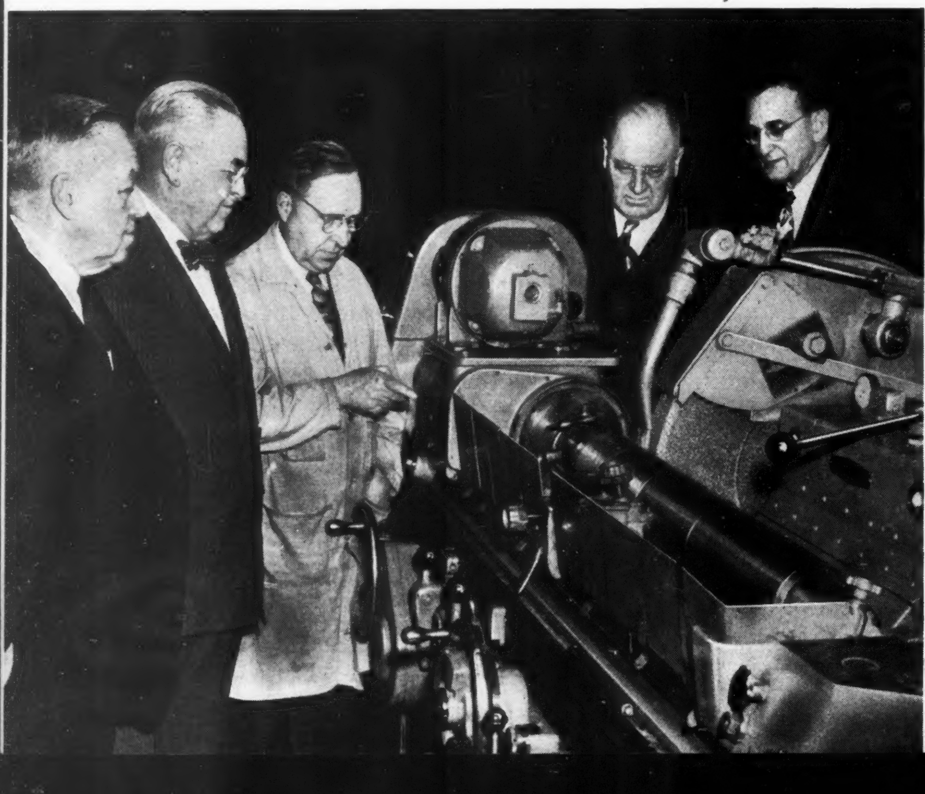
The Norton Emery Wheel Co.'s name was changed to the Norton Co. in 1906, when manufactured abrasives replaced natural emery and corundum in the manufacture of grinding wheels. However, the name Norton Grinding Co. continued to be applied to the grinding machine end of the business until 1919, when that division was merged with Norton Co., becoming the Grinding Machine Division, as it is now known. Norton Co. was the first concern to make both grinding machines and grinding wheels. The decision to manufacture grinding machinery was largely due to Charles H. Norton (no relation of Franklin B. Norton of grinding wheel and pottery fame). Mr. Norton was a machine designer with the Brown & Sharpe Co. of Providence, R. I., who came to the Norton Emery Wheel Co. with plans for the first production cylindrical grinding machine. His plans went a step further than the use of the grinding wheel as a polishing tool, which was prevalent in those days. He conceived the idea that grinding could remove greater amounts of metal and in many cases supplement the lathe as a production tool.

Mr. Norton and his associates were responsible for many developments originated by the Norton Grinding Co. in the early years of this century, including crankshaft and camshaft grinders, roll grinders, flat surface grinding machines, fully automatic cylindrical grinding machines, and machines for lapping. In all, over 41,000 grinding machines have been turned out by the company since 1900.

Charles H. Norton was awarded the John Scott Medal in 1925 for his many accomplishments in the field of grinding, perhaps best demonstrated by the more than one hundred patents held in his own name. He retired in 1925, and died at the age of ninety-one in 1942.

* * *

The largest volume of production of stainless steels is in the United States, averaging for the last four years about 550,000 ingot tons.



Men who were among the associates of Charles H. Norton in the development of cylindrical grinding at the Norton Co., and who are still active in the company. (Left to Right) Herbert J. Griffing, manager, Labeler Section, Grinding Machine Division; Frank W. Smith, vice-president and manager, Grinding Machine Division; John Cook, foreman, Department No. 8, Grinding Machine Division; Albert G. Belden, manager, Research and Engineering, Grinding Machine Division; and Iver G. Freeman, factory manager of Grinding Machine Division

Tool Engineering Ideas

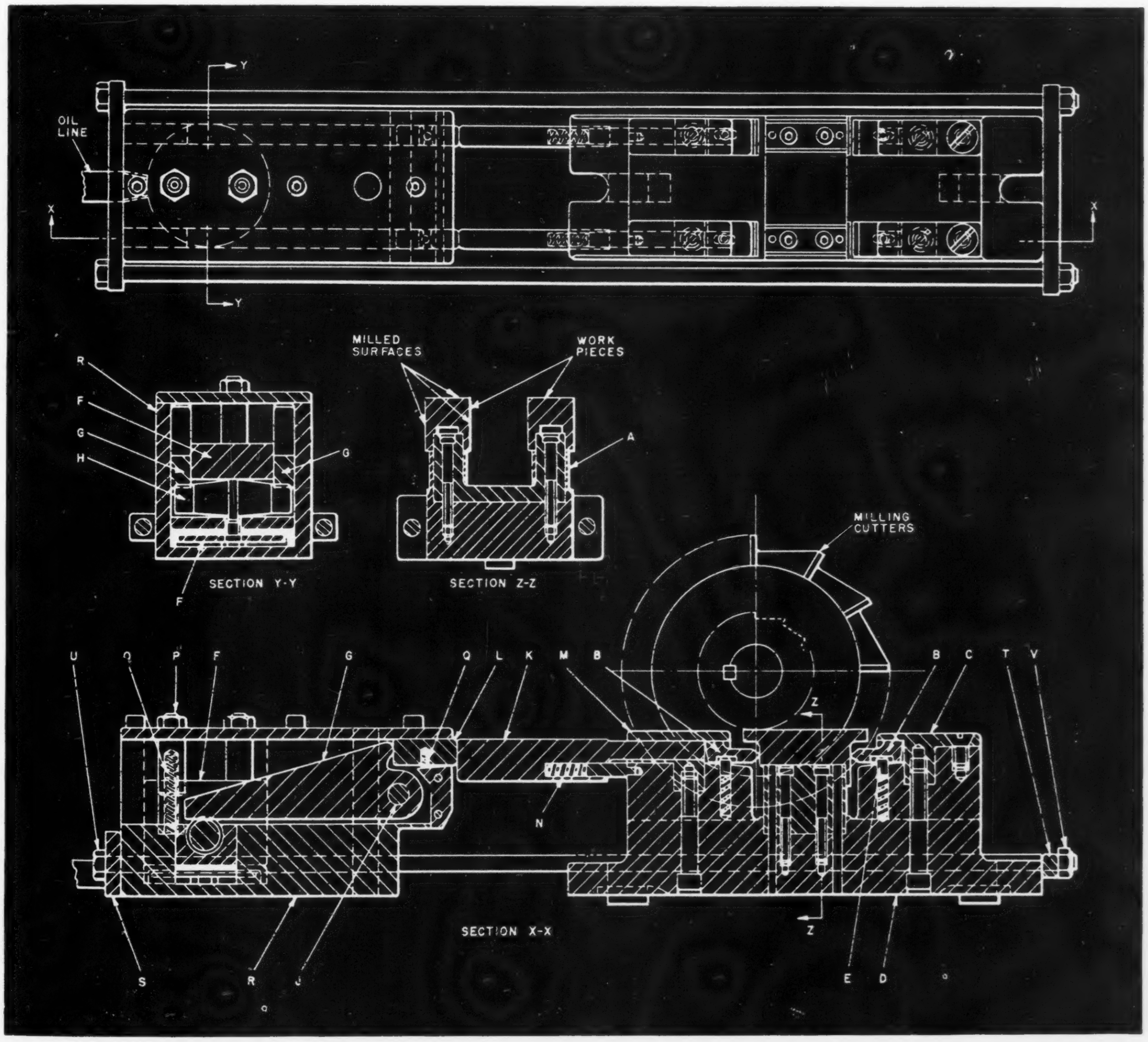
Tools and Fixtures of Unusual Design, and Time- and Labor-Saving Methods that Have been Found Useful by Men Engaged in Tool Design and Shop Work

Milling Fixture with Hydraulic Clamping Arrangement

By ROBERT W. NEWTON, Watertown, N. Y.

As part of a retooling program to offset increased labor costs, the milling fixture here shown was redesigned to provide means for hydraulic clamping. Two square-head set-screws, employed for clamping on the old fixture, were satisfactory when production requirements were low, although about six applications of a wrench were necessary to clamp the work-pieces tightly. This proved to be a slow and expensive method when production was tripled to about 7000 parts per month.

The improved design fixture is inexpensive to build and operate. Savings resulting from its



Top and both sides of two air control slide valves are milled simultaneously in this fixture. The valves are accurately and rigidly clamped by a combination of hydraulic pressure and leverage

use are approximately 1 cent per part, and operator fatigue has been reduced considerably.

The part milled in this fixture is a slide valve for a sensitive, compressed-air control system. The surfaces of the part must be machined smooth and square within fairly close limits. In this operation, the top and both sides of two parts are milled simultaneously. The inner faces of the projecting wings on the under side of the valve are machined in a previous operation, thus providing a sliding fit on the locating lugs of block *A*.

As each part is slipped on the locating block, it is pushed in contact with a chisel-pointed clamp *B*. The two clamps are a sliding fit in containers *C*, and their back faces are beveled to form a 5-degree angle with the containers. The bearing surfaces of fixture body *D* on which the clamps rest are also machined to a 5-degree bevel to insure that a downward clamping action will always be exerted on the work. Spring-loaded pins *E*, which engage slots in the bottom of the clamps, prevent movement of the clamps except when pressure is applied by the hydraulic clamping arrangement.

Pressure is applied to piston *F* by depressing a hydraulic oil control valve (not shown). This pressure is transmitted equally to levers *G* through rocker pin *H*. The levers pivot about pin *J* and transmit increased pressure to the two sliding arms *K* through blocks *L*. Two additional clamps *B*, sliding in block *M* and on body *D*, provide downward clamping action on the work.

The combination of hydraulic pressure and leverage provides a minimum clamping pressure of 200 pounds. While oil is piped from the base of the milling machine in this particular application, compressed air would be satisfactory provided hydraulic pressure were not available. If air were used, a larger cylinder would be advisable, as high pressure is necessary for clamping.

When the hydraulic pressure is released after the milling operation, springs *N* return the sliding arms *K*, blocks *L*, and levers *G* to their original positions. Simultaneously, the two springs *O*, mounted in guide pins *P*, return piston *F* to its initial position. Springs *Q* hold blocks *L* up against the cover plate that is bolted to housing *R*, and help return the blocks to their original positions when the pressure is released.

Body *D* of the fixture is bolted to the milling machine table. Housing *R* is connected to the fixture body by bars *S* and *T*, bolts *U*, and nuts *V*. The relative location of body and housing, and the horizontal distance through which blocks *L* move, can be adjusted by tightening or loosening the nuts. Levers *G* are a sliding fit in slots in the housing, and rest on steps machined on the piston.

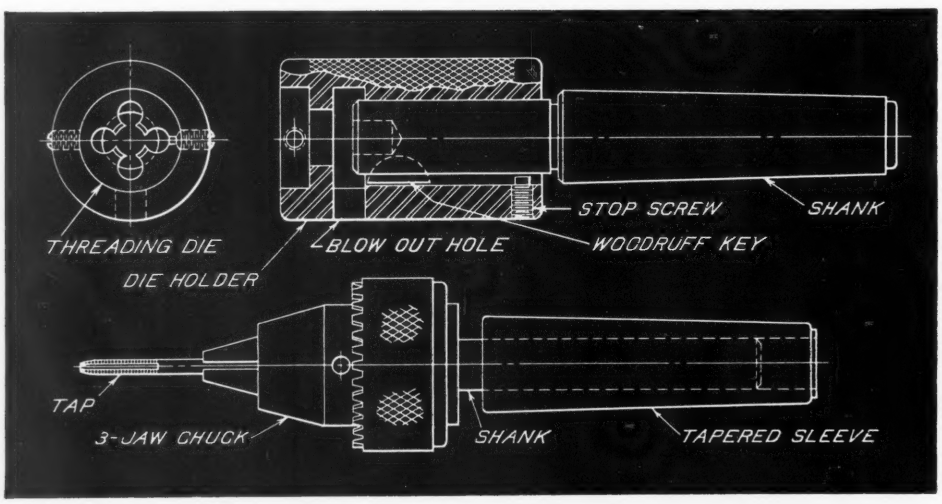
The work-locating lugs on block *A* must be square, parallel, and accurately machined to provide a sliding fit for the parts. The lugs were originally made as two separate pieces, but it was found that the desired accuracy was difficult to maintain when either lug had to be replaced.

When the fixture has been idle for an extended period, the cup gasket on the piston should be replaced before attempting to use the fixture. It is also important that a strainer be provided in the oil line to prevent chips from entering the cylinder.

Lathe Tailstock Adapters for Threading Small Parts

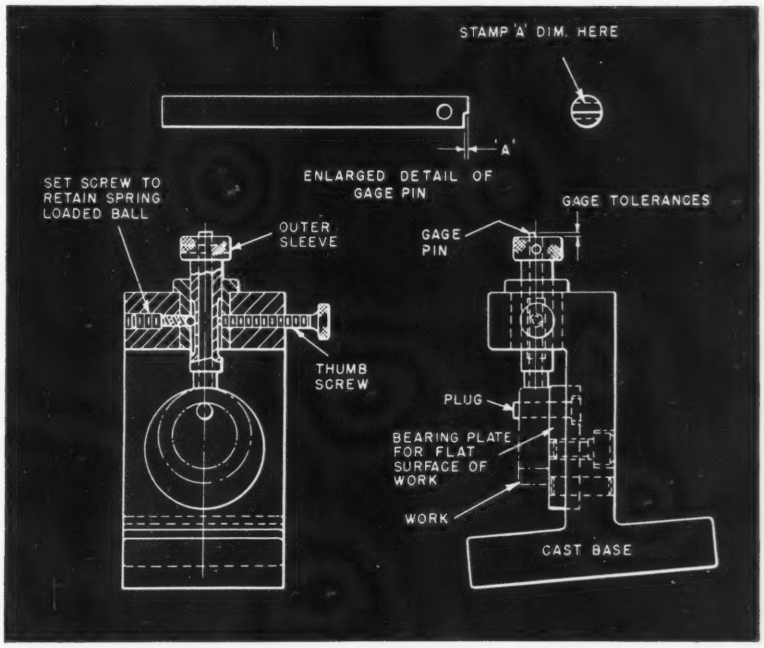
By CHARLES HOMEWOOD, Los Angeles, Calif.

Threading of small parts on a lathe can readily be accomplished by means of the two tailstock adapters illustrated. These handy attachments prevent forcing the lead or stripping the threads, and are especially suitable for fine threading.



Lathe tailstock adapters for external threading (above) and for tapping or drilling (below). The die or tap can slide to prevent stripping the threads

Flush-pin gage for quickly determining concentricity of different sizes of rings



The adapter for external threading, seen at the top, consists of a die-holder and a hardened and ground shank that fits into the lathe tailstock. A keyway in the bore of the die-holder permits the holder to slide along a Woodruff key on the shank. At one end of the die-holder there is a set-screw that acts as a stop and prevents the holder from sliding off the shank. Accumulated chips can be blown out by compressed air directed through a hole provided in the bottom of the holder.

The tap or drill adapter, shown at the bottom, consists of a chuck having a hardened and ground shank which slides within a tapered sleeve. The sleeve fits into the lathe tailstock. Rotation of the tap is prevented by gripping the knurled periphery of the chuck.

Flush-Pin Concentricity Gage for Large and Small Rings

By CARL THOMPSON, Racine, Wis.

The gage shown in the accompanying illustration can be used for quickly checking concentricity of both large and small rings. As indicated by the dot-and-dash lines, the work is placed on a locating plug with the flat surface resting on a bearing plate. The base of the gage is cast at an angle relative to the upright member to facilitate inserting the work.

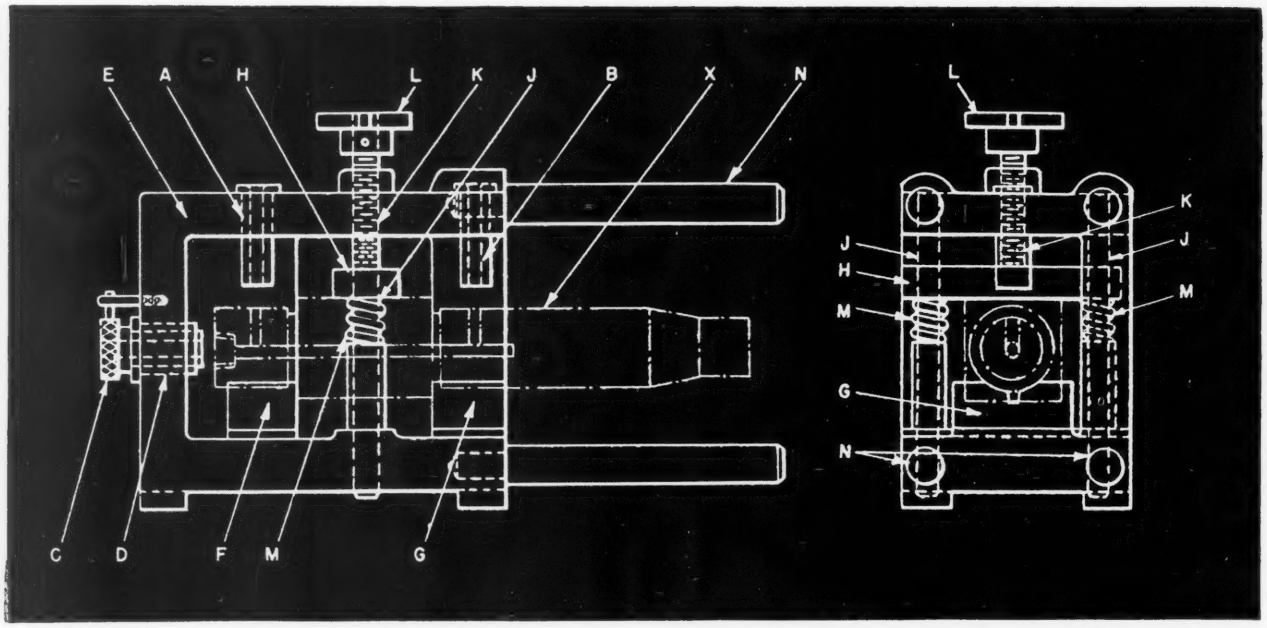
In using the gage, an outer sleeve is depressed to make contact with the outside diameter of the ring, after which the ring is rotated through one complete turn. When there is a difference in wall thickness, the outer sleeve will rise, remaining in the raised position as the result of pressure from a spring-loaded ball. After making this 360-degree rotation to position the outer sleeve at a point above the ring equal in distance to the greatest wall thickness, a thumb-screw is tightened to lock the sleeve in this position.

A hardened gage pin, ground to a close sliding fit inside the sleeve, has a step ground on the upper end equal in depth to the permissible amount of eccentricity between the bore and the outside diameter of the ring. With the gage pin inside the sleeve in contact with the periphery of the ring, the ring is rotated again through 360 degrees. As the gage pin rises and falls relative to the top of the outer sleeve, the step on the end shows whether concentricity of the ring has been maintained within the tolerance given.

It can be seen that rings of various sizes can be placed on the locating plug for measuring concentricity with this gage. Also, a set of gage pins can be made for inspecting rings having different concentricity tolerances.

Drill Jig that Locates Multiple-Diameter Shaft by Square Section

A jig that employs only one clamping member to hold the work in place while drilling three holes is shown in the accompanying illustration. The work, shown outlined in broken lines at *X*, is a short, multiple-diameter shaft having a square cross-section near its center. The square section is used to locate the part both radially and longitudinally.



Two holes are drilled and another hole is drilled, counterbored, and tapped in shaft (X), while the shaft is accurately located and securely held in this jig. A square section of the multiple-diameter shaft fits between V-blocks (F) and (G)

Three holes are drilled in the work, two in one side through bushings *A* and *B*, and one in the end of the shaft through slip bushing *C*. Bushing *C* can be removed from bushing *D*, so that the hole can be counterbored and tapped to receive an oil fitting. Attached to frame *E* of the jig are two V-blocks *F* and *G*, which support the shaft at the desired height. The spacing of the V-blocks is such that the square section of the work will just slip between them, thus locating the shaft longitudinally.

Clamping bar *H* is a sliding fit over guide posts *J*. The bar is clamped against a square side of the work by tightening screw *K* with hand-knob *L*. The work is thus located radially for drilling the two side holes in the proper relation to the squared sides of the shaft.

Springs *M*, around guide posts *J*, lift clamping bar *H* clear of the work when hand-knob *L* is rotated counter-clockwise. The work can then be removed from the jig by lifting it out of the V-blocks and sliding it to the right. Four posts *N*, extending past one end of the work, serve as feet for the jig while the longitudinal hole is being drilled, counterbored, and tapped in the opposite end of the shaft. F. M.

* * *

According to the American Gear Manufacturers Association, the gearing industry showed an increase in volume of 10.5 per cent in May, compared with April. Based on 100 for 1935-39, the index figure for May is about 363.

Goggles with Plastic Face Masks

The American Optical Co., Southbridge, Mass., announces that the company's two foundry goggles (Nos. 305 and 306) are now supplied with a plastic face mask in place of the leather mask formerly used. The plastic mask can be sterilized by spraying, wiping, or dipping, and will retain its shape and properties. It should not, however, be boiled. When wet, the new mask will not shrink or curl, and it remains flexible and soft under exposure to moisture of any kind.

* * *

New Officers of American Society for Testing Materials

The following officers were elected at the fifty-third annual meeting of the American Society for Testing Materials in Atlantic City: President, L. J. Markwardt, of the U. S. Forest Products Laboratory, Madison, Wis.; and vice-president, Truman S. Fuller, engineer in charge of works laboratory, General Electric Co., Schenectady, N. Y.

* * *

Despite a strike closing the plants of the second largest maker of cars, automobile plants have been turning out 12,000 to 100,000 cars more each month than a year earlier. Shipments of steel to this industry in March broke all monthly records with a total of 1,208,000 tons.

THE SALES ENGINEER AND HIS PROBLEMS

By BERNARD LESTER
Lester, Hankins & Silver
Sales Management Engineers
New York and Philadelphia

Help the Shop Man Sell Management

A STARK reality today in the entire metalworking field is that management is only half sold on the wisdom of investing in new and better tools.

"Sure enough we need a new boring mill to cut costs," exclaims the shop man, "but just try and sell the boss on the idea. He looks at dollars in his fist right now."

"You're right," answers the boring mill salesman—"you sure need it. Facts show that. Too bad you got a boss like that." Opinions thus coincide and the buck is promptly passed!

But herein lies one of the greatest opportunities in selling shop equipment. Few shop men are salesmen, just as few doctors are piccolo players. We all have our special talents. However, the job of an equipment salesman is not only to sell, but also to help manufacturing men sell those above them. Doing this is vital in getting orders.

Management is beset with demands on limited funds. Like hungry wolves, department heads ask for a new cafeteria, a switching locomotive, a conveyor, or a group of machine tools. Yet management is human. Management has heart, as well as brains—interests, likes, dislikes, and opinions. Decisions are based upon human reactions as well as facts.

Thus, in selling management on an idea leading to an appropriation, we should follow the same old rules of selling equipment: (1) Gaining attention; (2) winning interest; (3) justifying the investment through facts that are proved; and (4) getting final action.

With the "dollar return" motive uppermost, attention and interest can be gained if backed up by facts and figures that justify the investment. But facts must be arranged and presented in a simple, attractive manner. They must be tailored to fit "management thinking," not necessarily "shop thinking." They must be dramatized to appeal not only through dollar savings, but also through personal interest.

Less tangible benefits than dollar savings are important, and in this area, the art of selling to management must be brought into play. New tools are cleaner and quieter than old ones. Their use leads directly to better factory conditions and greater satisfaction, contentment, and employe interest. They possess advertising and sales promotion value. They help satisfy management's personal pride.

How, then, can the equipment salesman help the shop man sell management?

1. Above all, team up with him. Don't take the ball out of his hands. Help him handle it.

2. Review with him all dollar and time facts to see that they are not only correct, but well arranged, attractively tabulated, and properly summarized. Cut out too much technical terminology, and reduce the presentation to a business proposal, full of human interest.

3. Think up all less tangible advantages and set them down, pointing out that today happy human relationships may mean more, indirectly, in dollar returns than mechanical equipment.

4. Make your selling arguments attract favorable attention by the use of interesting visual tools. Charts, simple sketches, models, and samples help. They carry ideas easily grasped by the business mind, and go far to establish confidence in the shop man's arguments for the need of new equipment. In many cases, large equipment appropriations have been made by directors based on model lay-outs set up in the directors' room. In the same way, through the use of models displayed in the office of the manager of a smaller company, a favorable decision may be reached. Remember that no good plant manager can possibly be as familiar with manufac-

turing equipment and details as his shop men. Thus the job of the salesman is to supply the shop man with the facts that will interest management and with aids in presenting them.

5. Agree with the shop man on the part you should take in presenting the case to management. Either he or you can take the lead, while the other acts as the supporting member. Often a brief rehearsal of procedure will help—particularly a review of management's probable objections and how best to meet them.

6. Never take full credit for the development of facts, arguments, or shop recommendations. The clever salesman does not assume the attitude before management that "he did it." He always passes the credit to the shop man. He supports him. He implies that management is fortunate in having shop men who are so far-sighted and interested in the company's progress. His aim is to build up the shop man in the eyes of management—never to discount him.

Every day recommendations for new tools get the "red light" from management. But this "red light" can be changed to "green" if the machine or tool salesman will help the shop man sell management.

Extension of Educational Efforts in the Carbide Field

EVER since carbide cutting tools were introduced, the companies engaged in carbide manufacture have spent a great deal of time and effort, along educational lines, in placing information before the tool-using industries pertaining to the remarkable results obtainable with these tools.

Feeling that most educational programs have been aimed at the management and supervisory level and have been based on general rather than specific plant problems, the Firth Sterling Steel & Carbide Corporation, McKeesport, Pa., is now expanding its educational program to include what the company calls "on-the-job shirt-sleeve" information. This engineering service covers seven different groups of carbide applications as follows: (1) Cutting tools; (2) wire, bar, and tube reduction; (3) cold-heading; (4) compacting; (5) blanking and forming; (6) wear parts and special applications; and (7) mining applications.

Resident engineers in the principal marketing areas will be available to help industrial plants with their day-to-day problems. These men have had special training so as to be capable of recommending proper design, use, and maintenance of carbide tools, and instructing on the brazing, grinding, and finishing procedures, as well as recommending die and tool-room lay-outs.

The sales and service engineering staff has available for the solution of day-to-day problems a "Carbide Application Manual" containing actual operating data, design and grade recommendations, production possibilities, and other information sought by prospective users. Sections of this manual may be made available for plant use, and copies of certain sections will be distributed to plant personnel.

An organized lecture program is also carried on, and talks are being made to plant personnel based on an actual study of specific operations performed by the men attending the talks or lectures. When a job-by-job plant analysis has been made by one of the carbide specialists, the recommendations are submitted to the supervisory personnel and carried out with the assistance of the resident carbide engineer, who periodically reviews the methods used and the progress made. There is no attempt in this extension of the information service to cover generalized training or recommendations, the aim being to concentrate on individual problems.

* * *

New Tube Mill Turns Out 100,000 Tons of Welded Pipe a Year

A new tube mill with an annual capacity of 100,000 tons of electric welded steel pipe, in sizes from 26 to 36 inches, started production last month in McKeesport, Pa., at the National Works of United States Steel's National Tube Co. Stock for the mill consists of plates from 1/4 to 1/2 inch in thickness. These plates, whose steel composition ranges from 0.20 to 0.30 per cent carbon and from 0.85 to 1.25 per cent manganese, weigh close to 2 tons each. The standard length of the plates is 40 1/2 feet, while the widths will vary, according to specifications, from 78 1/2 to 110 inches.

* * *

The modern blast furnace—with its daily production of 1500 tons of iron—is a far cry from a unit of the early eighteenth century having a daily production of 1 to 6 tons, or a unit of the late nineteenth century having a daily output of 200 to 300 tons.

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

Thompson Surface Grinders

The Thompson Grinder Co., Springfield, Ohio, announces a new line of vertical-spindle, reciprocating-table surface grinders, which are made in fixed-column and sliding-column ("Hydrovert") types. The fixed-column style of machine is shown in Fig. 1, and the sliding-column type in Fig. 2.

The new vertical-spindle, fixed-column surface grinders include many of the features of the horizontal-spindle machines built by this concern, giving them a capacity for high stock removal, with precision and ease of operation. All machines are fully hydraulic with simplified circuits.

The wheel-head unit has a built-in motor. A heavy spindle is mounted in super-precision pre-loaded ball bearings to take the radial load, and spring-loaded ball bearings for the thrust load, all of which are "lifetime lubricated." The grinding wheel load is indicated by a horsepower meter, and the entire unit is dynamically balanced.

The bed is of heavy ribbed construction, with one vee and one flat way, automatically lubricated. The ways are completely covered at all times. The beds of these grinders are double the length of the machine working stroke, eliminating table work-surface overhang. A single lever control, which declutches the elevating handwheel, provides a vertical rapid traverse of the wheel-head.

The extreme limit of the table stroke is available without danger of damage to the table cylinders, as the table automatically slows down before coming to rest at the limit of the cylinder stroke. Automatic down feed is supplied to the wheel-head, affording increment feeds of 0.0002 to 0.004 inch at each reversal of the table. The down-feed is accurately stopped when the work size is reached by means of a pre-set size control. Angular adjustment of the wheel-head up to 10 degrees is provided.

A swinging type wheel-truing device with micrometer adjustment is rigidly mounted on the wheel-head, affording quick means of accurate wheel dressing. The table of the grinder is of heavy ribbed construction, and is provided with T-slots. The work surface can be positioned clear of the wheel at either end of the stroke.

Fig. 1. Thompson fixed-column, vertical-spindle surface grinder

To obtain additional information on equipment described here, use Inquiry Card on page 215.

Dual hydraulic cylinders drive the table at the rate of 0 to 100 feet per minute. Ring or cylinder wheels are furnished as standard equipment, but segment wheels can be provided at slightly extra cost.

The column is of heavy one-piece construction, with long guiding ways having square bearing design. All bearing adjustments are made with taper gibs. A flame-hardened guideway supports the wheel-head casting on the column. An exclusive feature of this machine is an anti-friction elevating nut, which permits feeding the wheel-head to an accuracy of 0.0001 inch without the use of a counterweight. Over-travel of the wheel-head when the power rapid traverse is used is prevented by a limit switch.

The "Hydrovert" sliding-column grinder provides an economical means of production where wide flat surfaces are to be ground, without the limitations ordinarily imposed by the size of the grinding wheel. This machine can use a smaller wheel, taking deeper cuts at greater efficiency, because of the sliding column, which enables work many diameters wider than the largest grinding wheel to be ground.

At the same time, the sliding column permits grinding close to shoulders, and affords a flexibility of head action for such operations as grinding dies, where the guide pins would interfere with the operation on fixed-column vertical grinders. In addition, the sliding-column grinder makes possible the grinding of flat surfaces in various steps or levels.

The "Hydrovert" grinder has most of the features described for the fixed-column type machine, differing only in the column construction. The column of the former grinder travels back and forth on a sub-base, giving either an intermittent feed at each reversal of the table or a continuous cross-feed, both of which are actuated by a single lever. The machine is also equipped with a hydraulic hand cross-feed for rough setting of the wheel and for grinding close to obstructions or shoulders. The smaller wheel used on this machine, in combination with the intermittent cross-feed, allows the use of a harder wheel and a greater depth of cut. The coolant is applied both inside and outside the wheel. E-61

General Electric Arc-Welding Electrode

An improved arc-welding electrode—the W-52 (AWS Class E7010) reverse-polarity, direct-current rod—has been announced

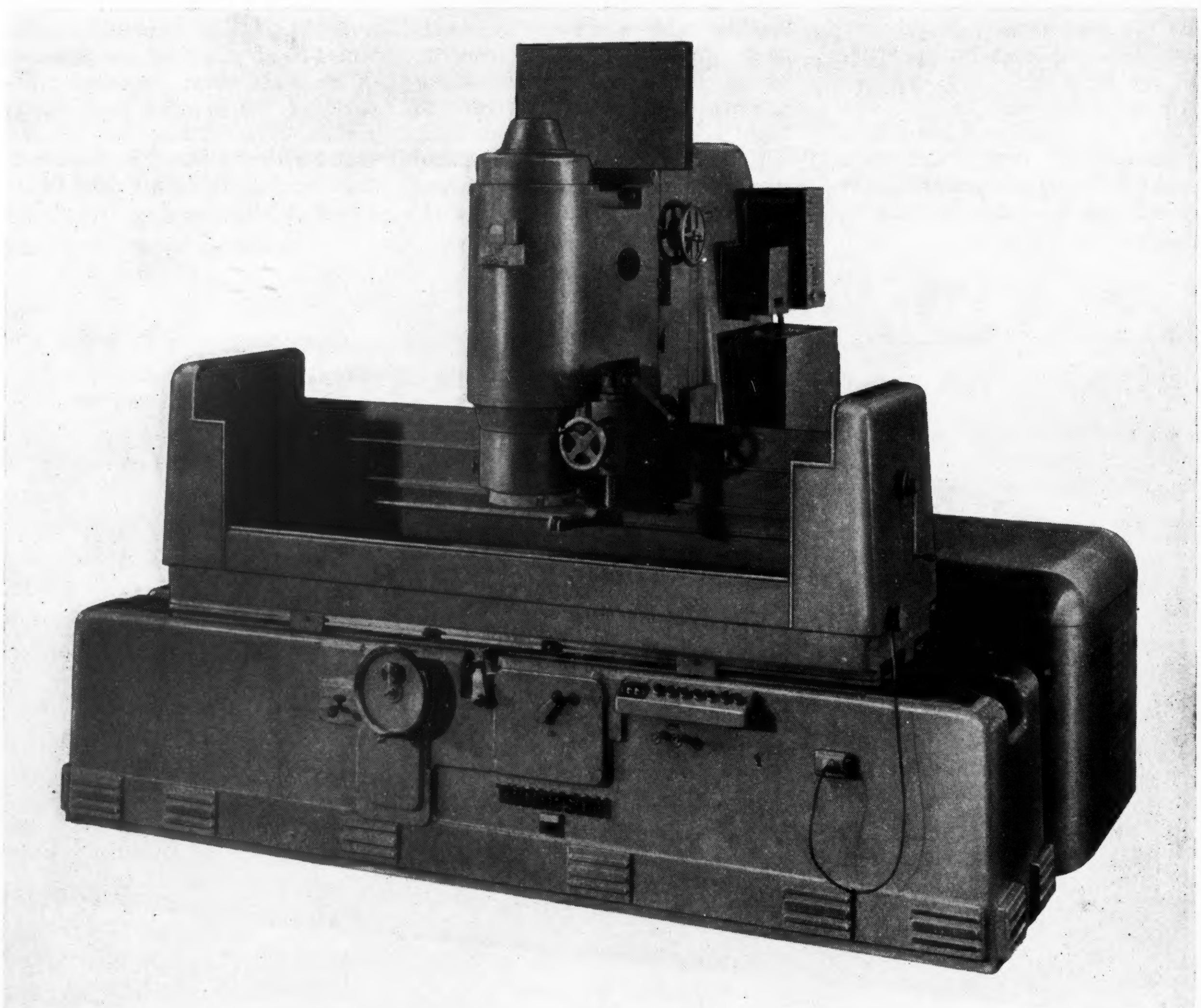
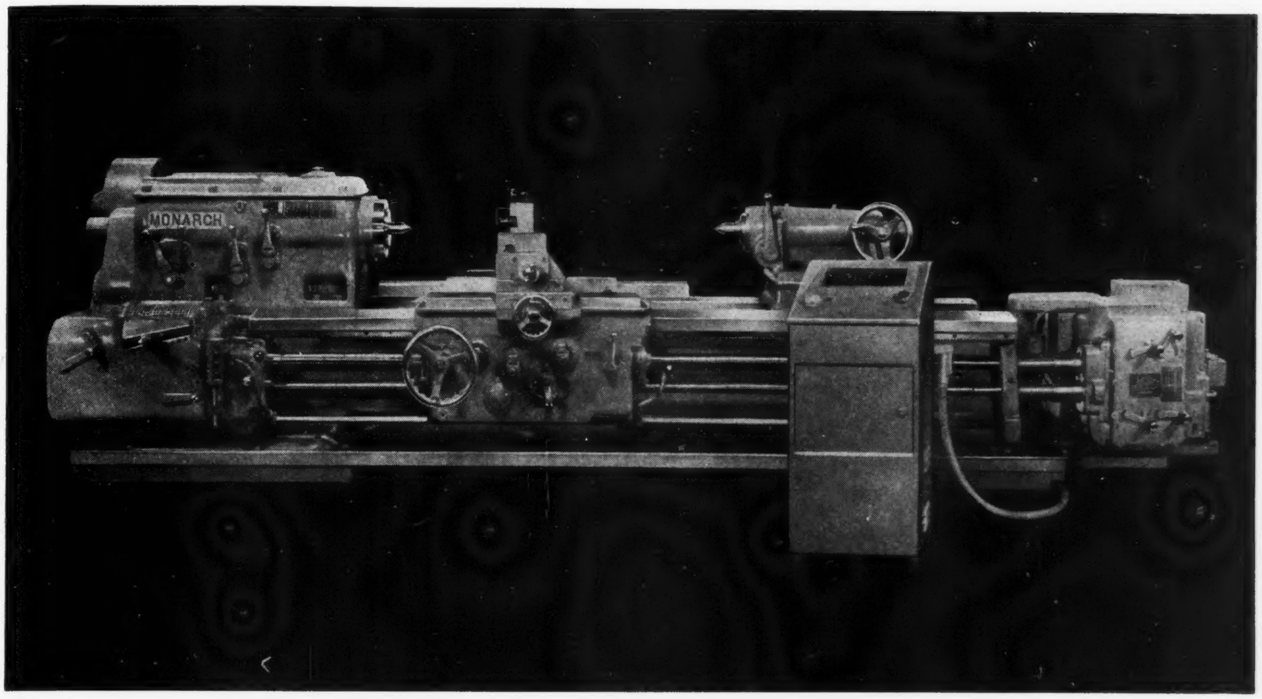


Fig. 2. Thompson "Hydrovert" (sliding-column), vertical-spindle surface grinder for grinding work having obstructions

To obtain additional information on equipment described here, use Inquiry Card on page 215.



Monarch roll-turning lathe designed for the contour turning of steel-mill rolls up to 20 inches in diameter

by the General Electric Co., Schenectady 5, N. Y. The new electrode is available in 5/32- and 3/16-inch diameters for field trial.

This carbon-molybdenum electrode is specifically designed for welding low-alloy, high-tensile strength steels, such as are used in pipe lines, in all positions. It can be widely applied to the welding of high-pressure piping and castings where high tensile strength and resistance to creep at high pressures and temperatures are desired. Good bonding action at the fusion zone on horizontal fillets and less tendency to produce "pin holing" on vertical down welds are characteristics of this electrode. E-62

Monarch Roll-Turning Lathes

The Monarch Machine Tool Co., Sidney, Ohio, has developed two new templet-controlled engine lathes specifically for the contour-turning of steel-mill rolls up to 20 and 15 inches diameter, respectively. The new machines, identified as the Model NN and the Model N roll-turning lathes, are smaller adaptations of the heavy-duty roll-turner introduced by the company a year ago, which was designed to handle rolls up to 25 inches diameter.

Performance features are the same on all three machines. For example, rolls are turned on centers, permitting necks to be handled during the same set-up. Work may be loaded and unloaded faster in this way than when neck supports are used.

On the Model NN lathe, for rolls up to 20 inches diameter, shallow passes may be taken just as fast as on any roll-turning lathe, and occasional deep passes can also be handled satisfactorily. The distance between centers is 132 inches.

The Keller electrical contouring controls used consist of a magnetic clutch drive and feed-change box, tracer mechanism, and push-button control. The stylus of the tracer mechanism, which follows a thin metal templet, has three positions, determined by very slight pressure changes. One position produces a forward feed, the second a longitudinal feed, and the third a transverse feed. As variations in templet contour change the stylus pressure, magnetic clutches are engaged, actuating cross and longitudinal screws.

Of heavy-duty design, the headstock of the Model NN machine provides sixteen speeds from 8 to 405 R.P.M. with an 1800-R.P.M. motor. The drive to this headstock is either through a faceplate or through the spindle in the conventional manner. When the machine is to be used for turning a considerable number of rolls having diameters approaching the maximum, the faceplate drive headstock is recommended.

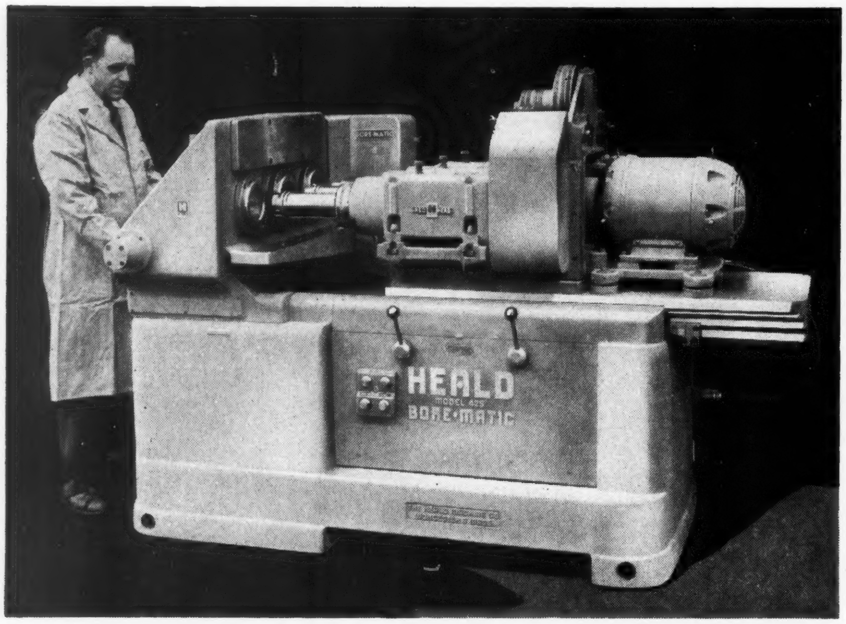
Twenty-four changes in speed are provided—sixteen through the spindle drive, ranging from 10 to 505 R.P.M., and eight through the faceplate, from 2 1/2 to 15 R.P.M. In addition to permitting heavier cuts on large work, this headstock, due to its low speed range, makes it practical to turn rolls by the form tool method.

To insure rigid support for heavy work under all conditions, a new heavy-duty, angular type tailstock is provided. The standard tailstock with an anti-friction center can be supplied for use where most of the rolls to be turned are in the smaller sizes.

The carriage, cross-slide, and tool-block are of the heavy-duty type. The apron provides automatic lubrication to all working apron parts, the cross-feed screw, bearing of cross-slide on carriage, and bearing of carriage on bed ways.

For contour turning of smaller rolls (up to 15 inches in diameter), the Model N machine is recommended. Ordinarily, rolls of this size do not have deep passes, but the machine will handle an occasional deep pass if necessary. The distance between centers on this machine is 96 inches. E-63

To obtain additional information on equipment described here, use Inquiry Card on page 215.

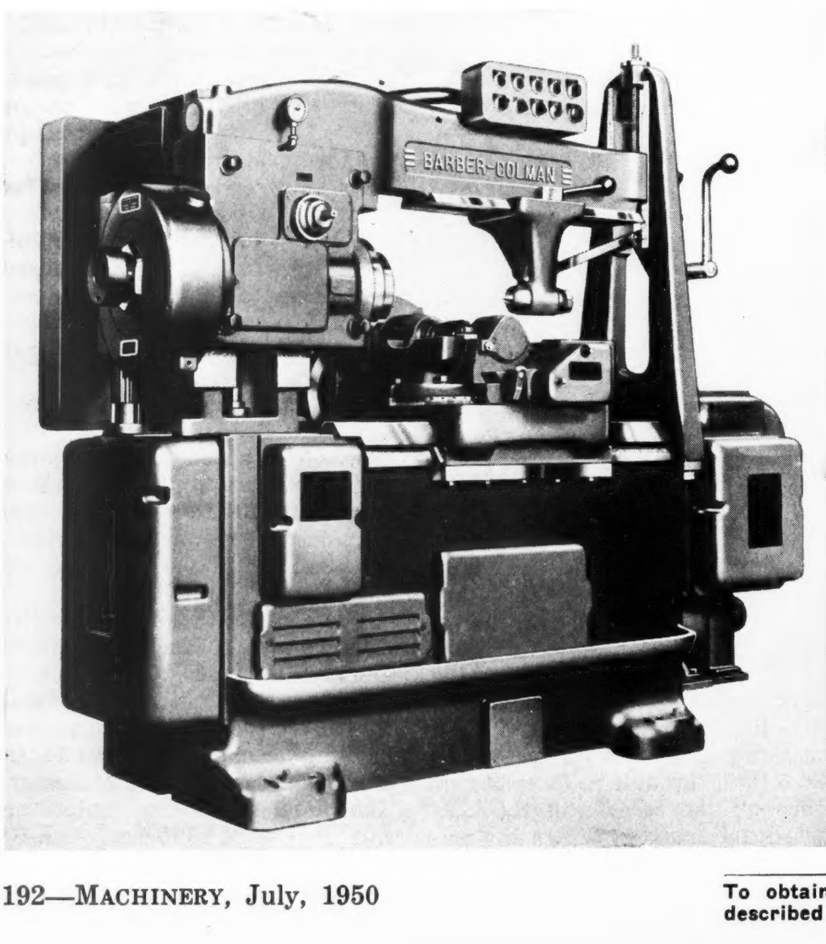


End-loading "Bore-Matic" brought out by the Heald Machine Co.

Heald End-Loading "Bore-Matics"

Two new end-loading "Bore-Matics" (Models 425 and 426) have been announced by the Heald Machine Co., Worcester 6, Mass. These machines differ from other Heald end-loading models in that the fixture and work are on the bridge, while the boring heads and motors are on the table.

The Model 425 machine, shown in the accompanying illustration, is arranged with a stationary fixture, while the Model 426 Bore-Matic has an indexing cross-slide on the bridge, which allows three work-pieces to be loaded while three other pieces are being machined. E-64



Barber-Colman Hobbing Machine of Improved Design

An improved model of the No. 16-16 gear-hobbing machine has been brought out by the Barber-Colman Co., 1302 Rock St., Rockford, Ill. The purpose of this improved model is to provide closer control over finish and accuracy and to increase job output and flexibility. The Barber-Colman automatic hob-shifter is available as extra equipment on the new hobbing machine. This shifter is of the mechanical type, electrically actuated to shift in increments as small as 0.0026 inch. It can be moved either forward or in reverse by changing a selector lever, and automatically resets the hob in a new cutting position after each machine cycle.

The hob-slide has been redesigned, and is constructed in such a manner as to prevent chips lodging between the gibs and the ways of the hob slide and swivel. The gibs have been extended the full length to increase rigidity.

The hob-spindle is now provided with a standard milling machine taper to reduce the possibility of damaging the hob-spindle bearing by drawing up the hob arbor too tightly. The spindle is also fully supported at both front and rear for maximum accuracy. The structure of the upright has been altered to increase the hob swivel range to 40 degrees, right-hand helix, with 6 inches minimum clearance between the face of the work-spindle and the center line of the hob swivel.

The machine bed has been redesigned to incorporate one flat and one vee way, providing greater accuracy and rigidity.

A complete rearrangement of the feed-box has also been made. An electrically actuated jaw clutch is used to engage the feed. Preset stops on a new design of feed control selector are actuated by limit switches. This arrangement makes it simple and easy to set up the machine for the desired travel, feed, and traverse distances.

All feed, index, and differential change-gears have been made

Barber-Colman gear-hobbing machine which has been improved in design to provide close control over finish and accuracy and to increase output

To obtain additional information on equipment described here, use Inquiry Card on page 215.

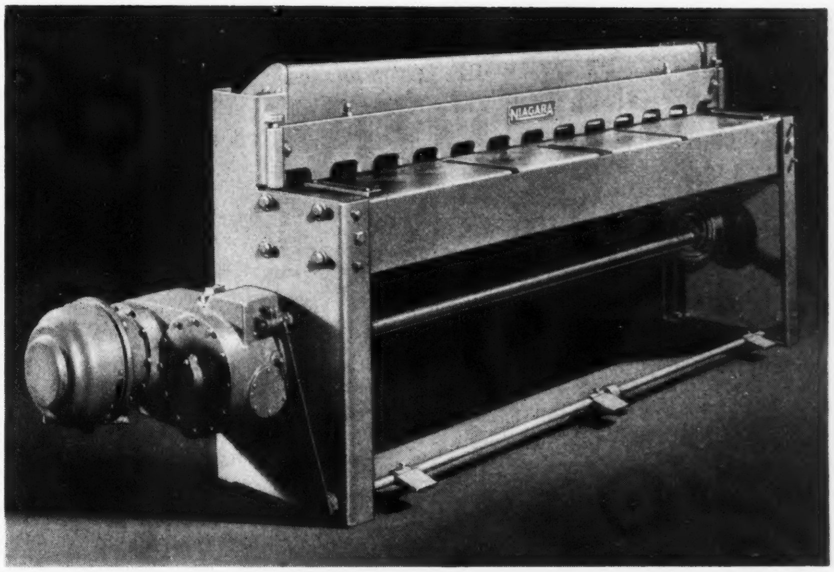
identical in design, with 30-degree involute splined holes, so that only one set of gears is required with each machine for universal operation. Helical speed-change gears, also with 30-degree involute splined holes, are used to insure quiet operation. Intermediate change-gear studs are directly connected to the central lubricating system for positive oiling at all times. A bronze index-gear replaces the former cast-iron gear to provide higher indexing speed. This feature is a distinct advantage when using carbide-tipped or "multi-thread" hobs. E-65

Millholland Automatic Indexing Machine

A new automatic indexing machine designed to perform drilling, reaming, tapping, counter-boring, chamfering, and spot-facing operations accurately to depth has recently been added to the line of the W. K. Millholland Machinery Co., 6402 Westfield Blvd., Indianapolis 20, Ind. This machine incorporates three No. 2 Millholland automatic units of the standard self-contained type with 1 1/2-H.P. capacity and 2 1/2-inch stroke. Two of the automatic units are mounted horizontally, at right angles to each other, while the third is at an angle.

The machine is arranged for continuous or intermittent operation by push-button control. The automatic units are mounted on sub-bases providing micrometer screw longitudinal adjustment. The multiple heads are equipped with a bushing plate for locating the part at each indexing.

On the particular operation shown in the illustration, a series of twelve holes is being drilled around the periphery of a flanged bushing and twenty-four holes in the flange end. The part is held in an air-operated collet chuck mounted on an automatic indexing spindle. The unit for drilling twenty-four holes is equipped with a four-spindle head, while the two other units at right angles are equipped with single spindles. The fixture spindle indexes six divisions automatically and then stops for loading. E-66

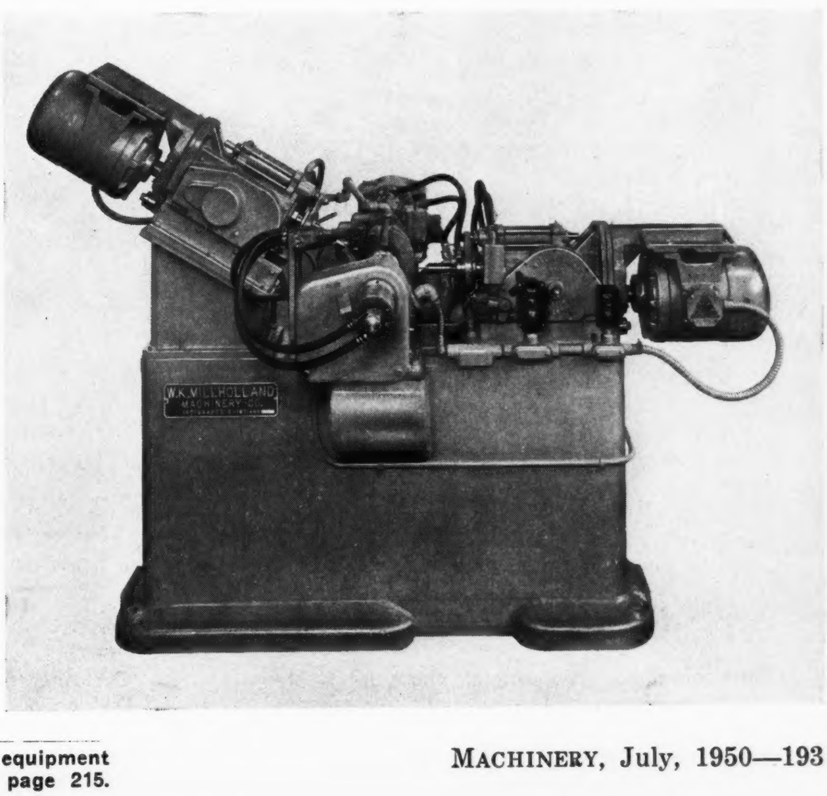


Power squaring shear recently announced by Niagara Machine & Tool Works

Niagara Power Squaring Shears

A new line of power squaring shears has recently been announced by Niagara Machine & Tool Works, Buffalo 11, N. Y. These "Series One" shears are fabricated from formed steel plates, and are equipped with knives having four cutting edges in place of single-edge knives, so that no time is lost waiting for a dull knife to be reground. The knife is simply rotated to a new cutting edge. Front gages, side squaring gages, and a precision ball-bearing, self-measuring back gage which can be indexed in increments of 1/128 inch are provided on these machines.

An electric foot switch can be furnished for remote control. This permits the operator to trip the shear from any convenient location when trimming long sheets or wide sheets extending the full length of the bed. The new "Hi-Power" drive has a completely enclosed transmission, in which all mechanisms including clutch, gearing, flywheel, and detent operate continuously in a bath of oil. The drive and the main shaft operate on anti-friction bearings. E-67



Millholland automatic indexing machine for drilling, reaming, tapping, boring, and similar operations

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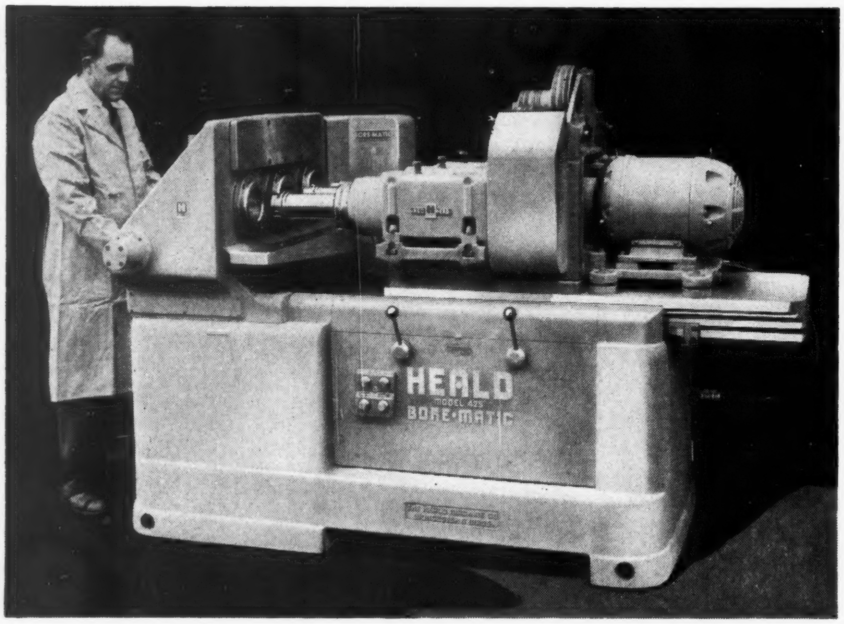

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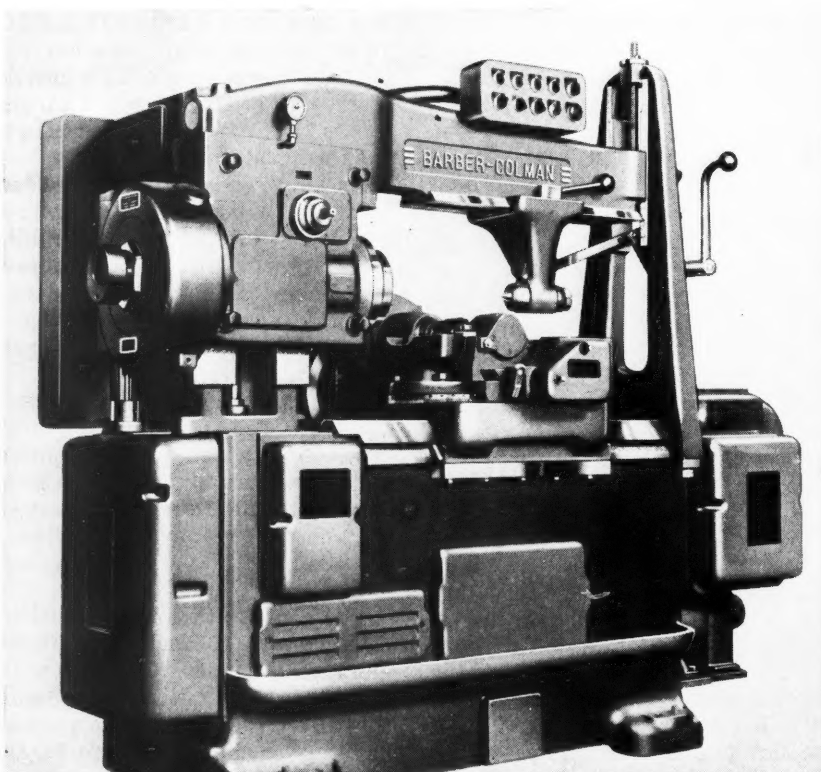

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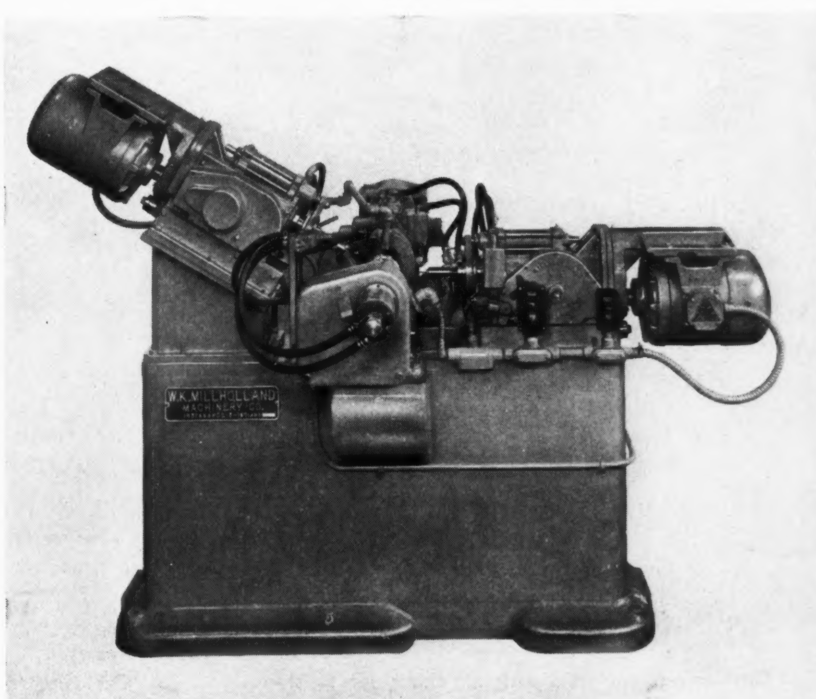

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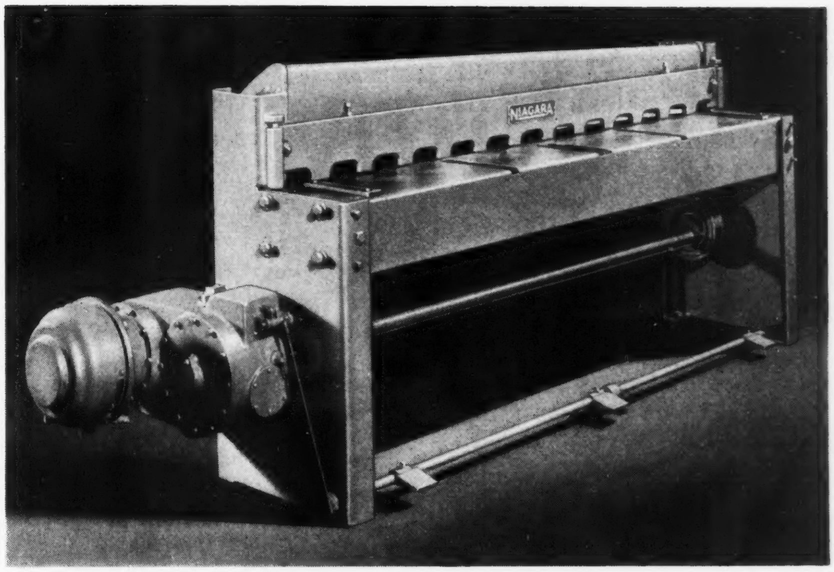

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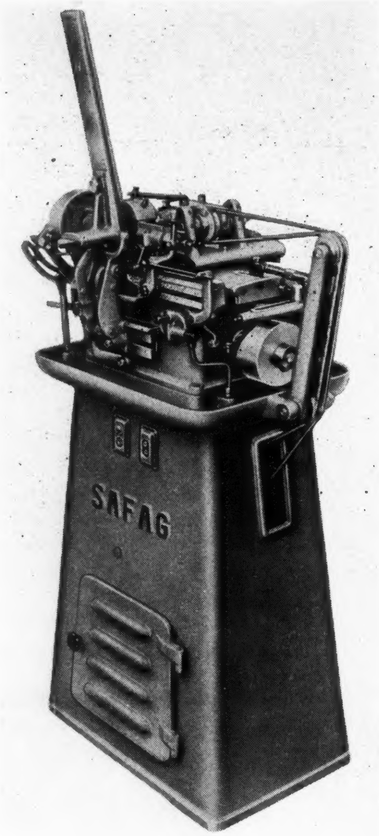
To obtain additional information on equipment described here, use Inquiry Card on page 215.

Gear Shaver Equipped with Air Chuck for Shaving Internal Gears

The illustration shows a gear shaver built by the National Broach & Machine Co., 5600 St. Jean Ave., Detroit 13, Mich., equipped with a diaphragm type chuck for performing internal shaving operations on planetary ring gears for automatic transmissions. This equipment is said to reduce loading and unloading time and lessen operator fatigue. It is especially adapted for handling work having comparatively large tolerances on the locating diameter. The operation corrects errors in involute profile, eccentricity, and tooth spacing.

The diaphragm chuck is mounted on the forward end of the internal shaving fixture, which is equipped with anti-friction bearings. A rotary valve at the rear connects the air supply to the diaphragm piston. The coolant is carried directly to the cutter through a line enclosed in the airline channel. The operation of the chuck is controlled by a handlever on top of the fixture, and the fixture is advanced and retarded by hand-levers. E-68



Swiss precision machine designed to cut small wheels, pinions, and segments

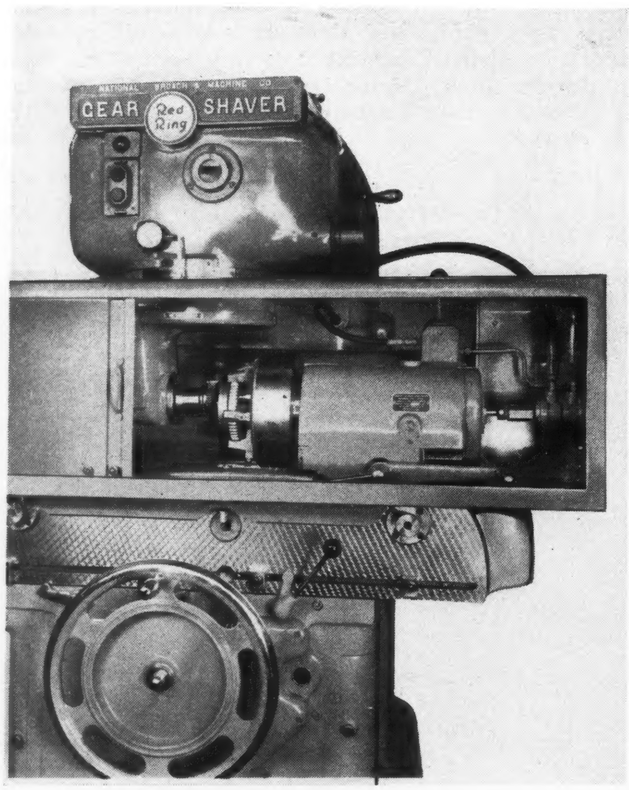
Swiss Automatic Wheel, Pinion, and Segment Cutting Machine

An automatic machine for the precision production of small wheels, pinions, and segments is being manufactured by Safag S.A., Bienne, Switzerland, for whom the Hauser Machine Tool Corporation, 30 Park Ave., Manhasset, N. Y., is United States representative.

This machine has a capacity for parts ranging from 0.04 inch to 2 inches in diameter. By utilizing one roughing and one finishing cutter, fine surface finish and high accuracy are assured throughout long production runs. The machine generates gears and pinions of 6 to 200 straight teeth in one cut and of 6 to 80 teeth in two cuts. E-69

Cleveland Cable Reel Grab that Handles Reels Vertically and Horizontally

The Cleveland Tramrail Division of the Cleveland Crane & Engineering Co., Wickliffe, Ohio, has developed a new cable reel grab equipped with a motor-drive ex-



Gear shaver equipped with air chuck for finishing internal gears used in automatic transmissions

Cable reel grab developed by Cleveland Tramrail Division of Cleveland Crane & Engineering Co.

To obtain additional information on equipment described here, use Inquiry Card on page 215.

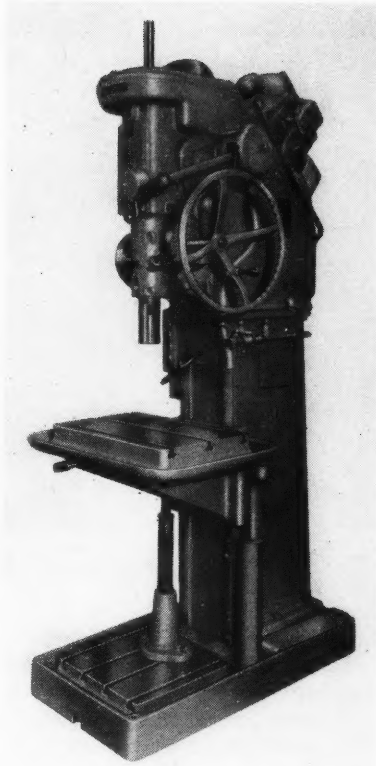
panding arbor for handling 5000-pound reels of copper wire. The arbor, when threaded into the reel cores and expanded, holds the reels securely in any position. A double hoist carrier, designed for use with the grab, hoists, conveys, and turns the reels.

The control of all motions is centered in a pendent push-button station. This enables the hoists to be operated independently or simultaneously.

The grab was made to handle reels 26 inches wide by 40 inches outside diameter with 5-inch diameter cores. Four motors are used—two for the hoists, each of 3 tons capacity; one for the carrier travel; and one for the expanding arbor. E-70

Barnes High-Production Drilling and Tapping Machines

New control features have been incorporated in a No. 201-1/4 drilling machine recently brought out by the Barnes Drill Co., 820 Chestnut St., Rockford, Ill. This machine has a single lever control for speed changes; single dial for operating feed changes; automatic depth control for tripping the feed at a predetermined position when drilling or for tripping the electric reverse provided for use when tapping.



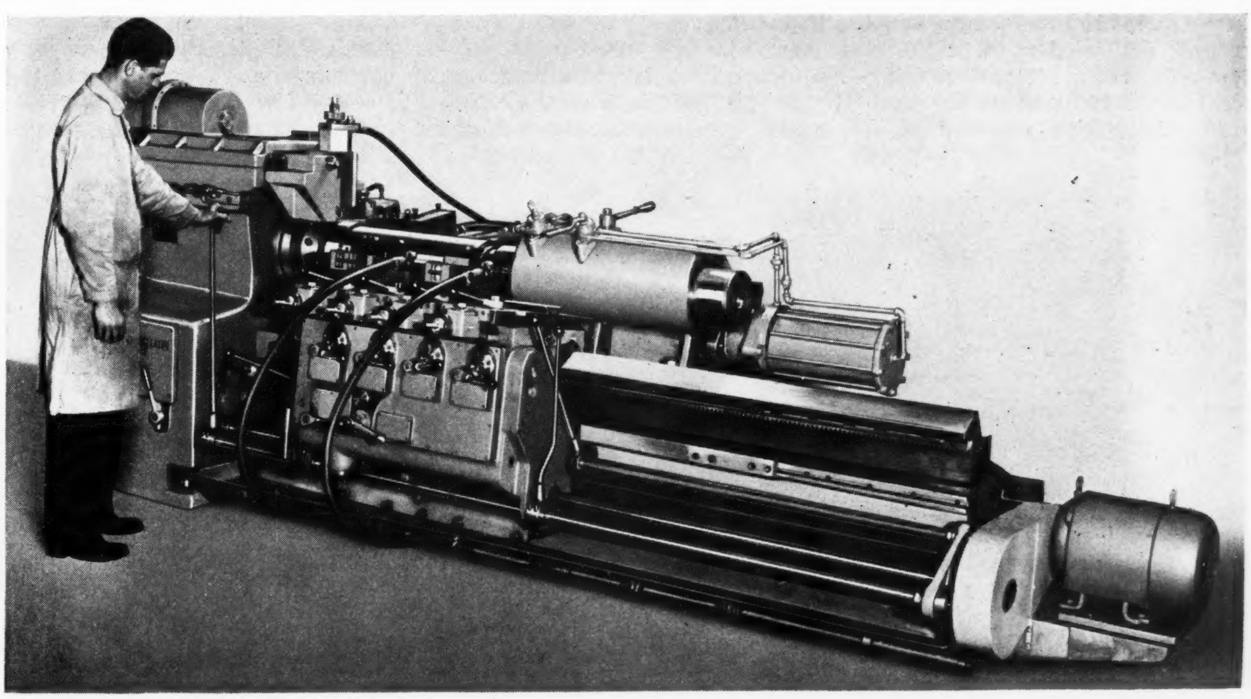
Drilling and tapping machine developed for high production by the Barnes Drill Co.

On regular drilling operations, the spindle rotates continuously and is returned to the starting position by a handwheel or automatically by means of a coil spring attachment. For tapping operations performed with the thread-leading feed attachment, the feed remains engaged and the direction of rotation is tripped for forward movement at the upper position. The circuit can be arranged to stop the cycle in this position or it can be set to continue the cycle uninterruptedly. Tapping can be performed by electrically operated reverse without engagement of the feed, the taps being started by pressure on the handwheel.

A wide range of geared speeds and feeds is available. The machine is made with one, two, three, or four spindles. All machines have a drilling capacity in S A E 1035 steel of 1 1/4 inches, based on 0.010 inch feed at 236 R.P.M. speed. All have a swing of 20 inches; distance from column to center of spindle, 10 1/4 inches; maximum distance from table to spindle, 33 1/2 inches; and vertical spindle travel, 12 inches...E-72

"Lo-Swing" Lathe for Multiple-Tool Turning

The Seneca Falls Machine Co., Seneca Falls, N. Y., has brought out a new semi-automatic "Lo-Swing" lathe that is an adaptation of a specialized lathe used extensively during the war for turning large gun tubes and high-explosive shells. This Model LS

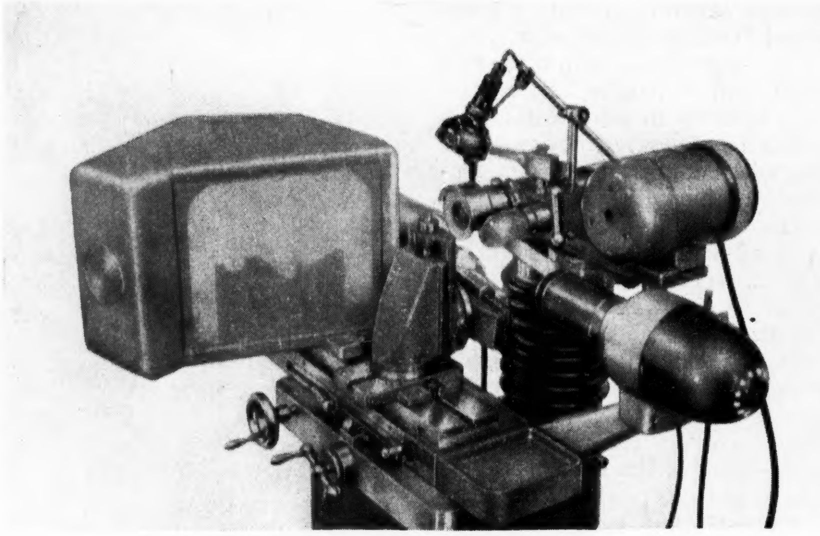


Semi-automatic "Lo-Swing" lathe, for heavy multiple-tool turning operations

To obtain additional information on equipment described here, use Inquiry Card on page 215.

machine retains many of the structural features of the original model, but provides greater versatility and ease of change-over. The principal change is in the design of the front carriage, which may now be equipped with two or more individually controlled, power-operated cross-slides that feed the tools into the cut. Tool cutting pressures are taken on large rolls, fitted to the bottom of each slide, which remains in constant contact with the cross-feed cam.

Other new features include cam-feed back-squaring attachments operating on an automatic cycle with push-button control; an adjustable stop for positioning the carriage in relation to the starting point of the cut; and automatic tool relief at end of cut. E-73



Optical profile grinding attachment for Nife universal tool grinder

"Magnaflo" Unit for Removing Ferrous Solids from Cutting Oils

Automatic removal of ferrous solids from cutting oils and water-soluble coolants is accomplished by a "Magnaflo" separator announced by the Industrial Filtration Division of the U. S. Hoffman Machinery Corporation, 219 Lamson St., Syracuse 6, N. Y. Two of the five sizes of units now in production are designed to serve individual machine tools with 20 to 40 gallons per minute flow-rate requirements. The three larger sizes are intended for small groups of grinders with total flow-rate requirements ranging from 60 to 100 gallons per minute. The sludge removed from the cutting oil or coolant is relatively dry before it drops into the discharge chute.

Vertical pumps of 1/2- and 3/4-H.P. sizes are furnished with the two smaller size "Magnaflo" units for individual tool installations. Larger size models do not include pumps, which are generally available in the plant. E-74

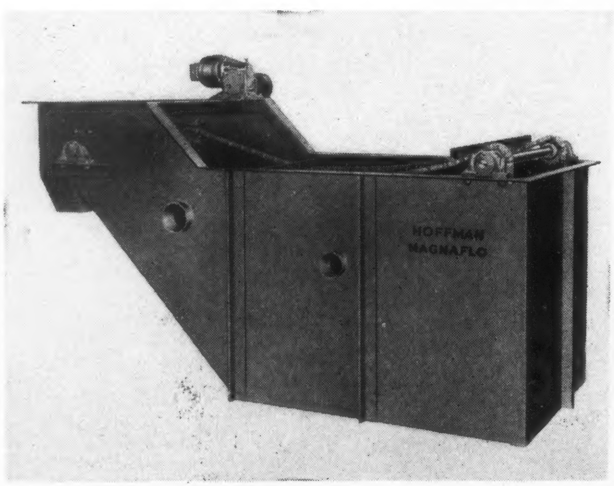
Nife Optical Profile Grinding Attachment

Optical profile grinding equipment has been developed for use with the universal tool grinder built by Nife Incorporated, 165 Broadway, New York 6, N. Y. As shown in the illustration, this equipment consists of a projector, a 12- by 10-inch screen, a work-holder on which can be mounted either a dividing head or a swivel vise, and a motor that drives the table at approximately 100 strokes per minute. An enlargement of 10 X is provided, which can be read accurately to about 0.0004 inch. The table has an adjustable movement of 1/4 inch to 1 3/16 inches.

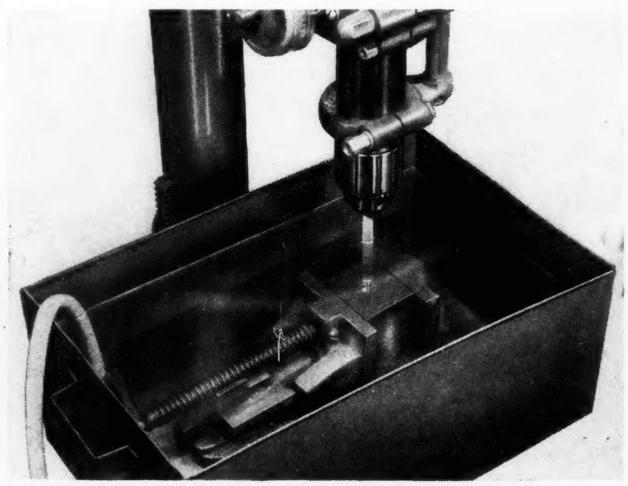
This equipment can be assembled to the tool grinder in about ten minutes. E-75

Black Improved "Hardsteel" Drill

The Black Drill Co., 1400 E. 222nd St., Cleveland, Ohio, has brought out an improved "Hardsteel" drill designed for drilling hardened and work-hardening steels. The improvement results from a change in the alloy mate-

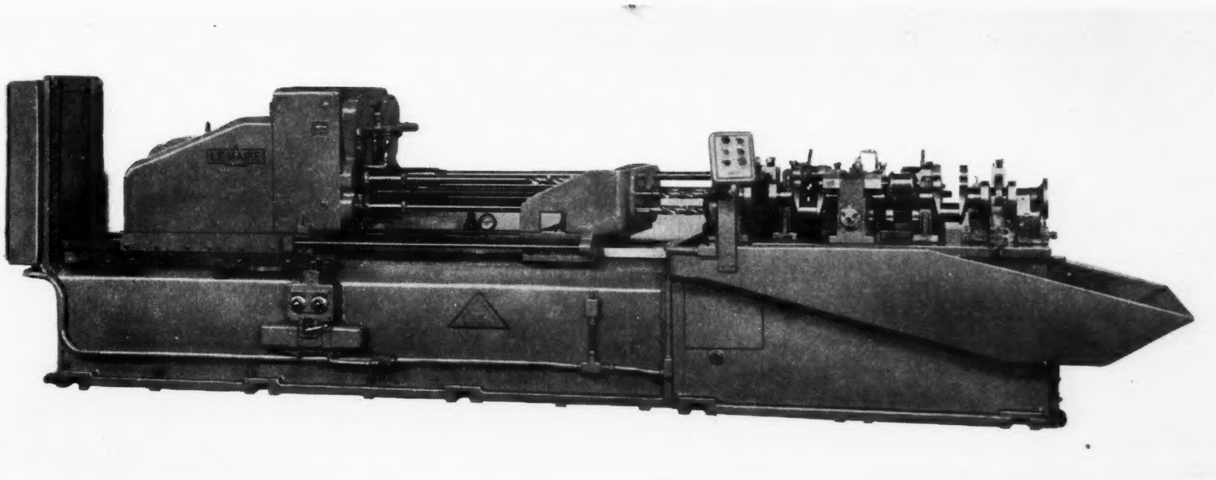


"Magnaflo" unit designed to remove ferrous solids from coolants and cutting oils



Improved "Hardsteel" drill used for submerged drilling of hard steel part

To obtain additional information on equipment described here, use Inquiry Card on page 215.



Le Maire six-spindle horizontal drilling and reaming machine that has a capacity for crankshafts 60 inches long

rial used for the drill. The new drill has improved torsional strength, which permits a wider latitude in drilling pressures and increased toughness.

The improved type drill is adapted for drilling parts completely submerged in water, as shown in the illustration, or for applications where a full flow of coolant is used. They can also be used for dry drilling if care is taken to avoid overheating. E-76

"Dero" Hollow Centers

Hollow centers provided with a replaceable disk having sixteen centers around its periphery, designed to eliminate the expensive dressing operation usually required when standard type hollow centers become worn, are being distributed in the United States by the Cosa Corporation, 405 Lexington Ave., New York 17, N. Y.

These "Dero" hollow centers are used in turning and milling, as well as in cylindrical and thread grinding. They are supplied with Morse tapers, Nos. 1, 2, 3, and 4, as well as with the special tapers used in standard tool-room lathes. E-77

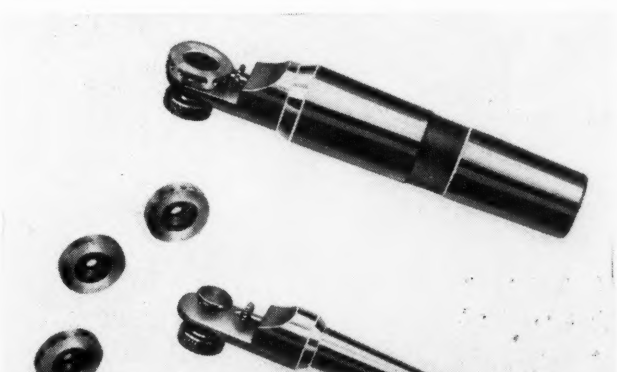
LeMaire Crankshaft Drilling and Reaming Machine

The drilling and reaming machine shown in the accompanying illustration was built by the LeMaire Tool & Mfg. Co., 2657 S. Telegraph Road, Dearborn, Mich., and is used for automatically drilling and reaming 1 5/8-inch diameter lightening holes in six crank throws of crankshafts 60 inches long. The machine is driven by a 20-H.P. motor, and has a LeMaire No. 20 H.S. hydraulic feed unit having 60 inches of feed and a six-spindle head, a fabricated steel fixture base, and two work-holding fixtures. A tool support, mounted on the ways, moves with the head, supporting the tools between the head and the drill guide bushings.

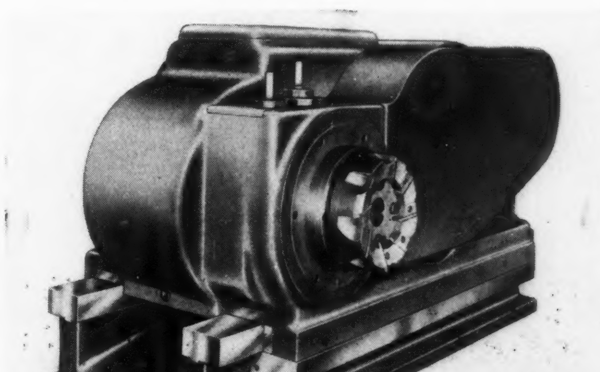
Two parts are operated on at the same time, one being drilled and the other reamed. The three drilling spindles are arranged to feed coolant through oil-tube drills, and the three reaming spindles have coolant flooded on the tools. E-78

Motch & Merryweather Milling Head for Production Milling

A milling head designed for production milling is now being manufactured by the Motch & Merryweather Machinery Co., 715 Penton Bldg., Cleveland 13, Ohio. All gears in the new head are in-



"Dero" hollow centers with replaceable disks having sixteen centers around their periphery



Milling head manufactured by Motch & Merryweather Machinery Co. for production milling

To obtain additional information on equipment described here, use Inquiry Card on page 215.

tegral or mounted solidly by taper and key to lock them in place on the shafts. Adjustment of the steel quill up to 2 inches for cutter wear is obtained by an Acme thread, and the movement is gaged by a micrometer dial. A flywheel effect is obtained by a large, heavy spindle gear. Lubrication inside the head to all bearings and gears is effected by a geared pump. Automatic lubrication is provided for the ways.

Although this milling head is arranged with a single speed for production work, using either high-speed steel or tungsten-carbide tipped cutters, change-gears can be provided. It is stated that the new milling head provides the necessary rigidity and horsepower at the tool point to give especially good results with carbide tools. The head can be adapted by the manufacturer for special production milling machines that provide for other simultaneous machining operations....E-79

"Hydro-Wynd" Drive that Insures Constant Tension in Wire Winding

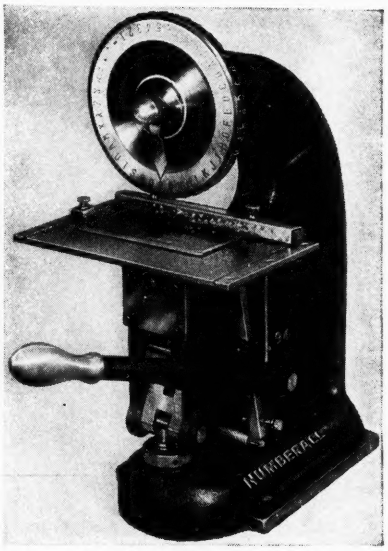
The problem of maintaining constant tension and lineal speed on wire and other winding operations has been solved by the development of the "Hydro-Wynd," a new product of the Twin Disc Clutch Co., Racine, Wis. This drive combines a hydraulic coupling with a planetary gear set, the ring gear of which is fixed to the impeller or pump of the hydraulic coupling. The planet gear is fixed to the runner of the coupling, while the sun gear is fixed to the output shaft.

As the torque load increases or decreases, the "Hydro-Wynd" increases or decreases the output torque—rather than the horsepower—in direct proportion to the load imposed. The result is said to be an extremely smooth, fast start, providing continuous operation at predetermined lineal speeds and tension without adjustments.

On applications where controlled tension is necessary despite day-to-day changes in materials, weights, or speeds, a variable-speed drive is used. When predetermined speeds and tensions have been set, further adjustments are unnecessary..........E-80

Numbering and Lettering Press with Automatic Spacer

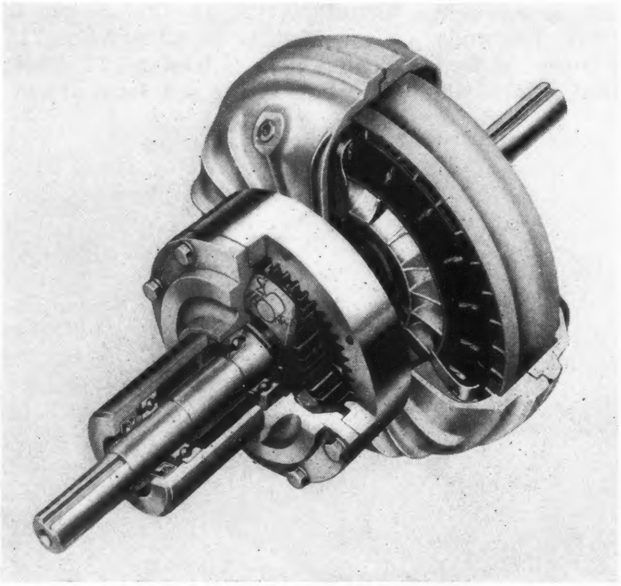
A numbering and lettering press with a "Mono Wheel" automatic spacer is announced by the Numberall Stamp & Tool Co., 379 Huguenot Ave., Huguenot Park, Staten Island 12, N. Y. It is used for stamping letters and numbers on nameplates and flat metal parts. Standard dials are engraved with forty-two characters in 1/8-, 3/16-, 1/4-, 5/16-, and 3/8-inch heights. The carriage table advances one space with each impression of the dial, similar to a typewriter. Plates up to 5 inches in width and 6 inches in length can be accommodated...E-81



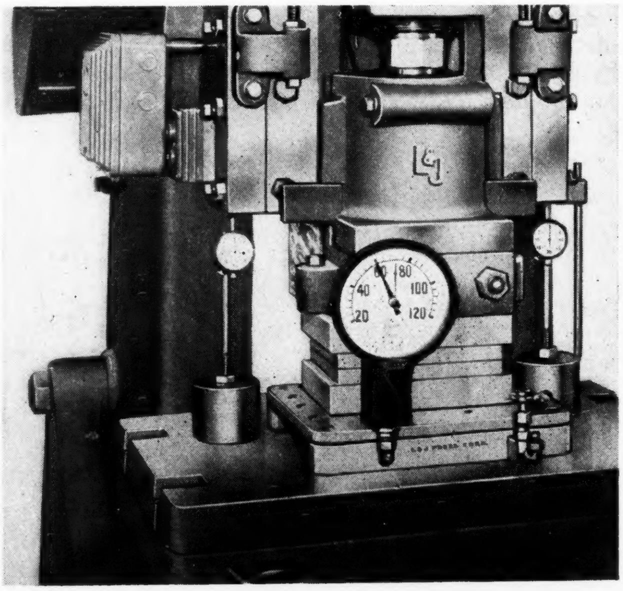
Numbering and lettering press equipped with an automatic spacer, made by Numberall Stamp & Tool Co.

Hydraulic Device for Measuring Ram Pressure

Users of punch presses who are concerned with the accuracy of stampings and die life will be interested in the announcement of



Constant tension and lineal speed are maintained in winding operations with the "Hydro-Wynd" drive made by Twin Disc Clutch Co.

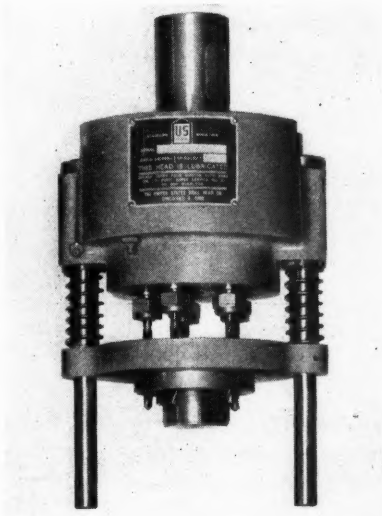


Hydraulic device with recording gage for measuring pressure exerted by punch-press ram and frame deflection at any pressure

To obtain additional information on equipment described here, use Inquiry Card on page 215.

a new punch press tester developed by the L & J Press Corporation, Elkhart, Ind. This consists of a hydraulic device with a recording gage, which is placed on the press bed to measure the pressure, in tons, exerted by the ram, either directly or through a die. At the same time, dial indicators, located at both sides of the bed and contacting the gib ways, measure any frame deflection.

Thus an accurate determination is obtained of the frame deflection at any ram pressure, as well as the ram pressure being applied on a job. E-82

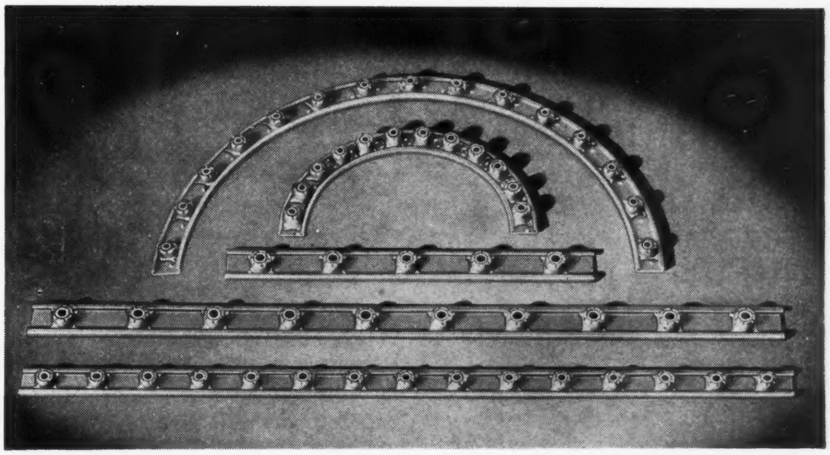


Drill head made by the United States Drill Head Co. for use on turret lathes

Multiple-Spindle Drill Heads for Turret Lathes

Multiple-spindle drill heads applicable to automatic turret lathes have recently been produced by the United States Drill Head Co., 616-618 Burns St., Cincinnati 4, Ohio. These heads are mounted on one or several turret faces of the lathe, and the drive to the various drill spindles is accomplished by using a center arbor surrounded by properly meshing gears. Precaution is taken to provide safety factors that will prevent the possibility of jamming the driver and the driven lugs as the turret-slide carries the head into its operating position.

Drill heads of this type, being designed for specific work, are entirely of the fixed-center distance variety, which permits greater use and more complete rigidity. E-83



Gang channel nut strip introduced by Elastic Stop Nut Corporation of America

Gang Channel Nut Strip for Permanent Fastening Applications

A gang channel nut strip with nylon locking inserts that provides permanent fasteners for cases where parts have to be repeatedly attached to an assembled unit and detached from it is a new product of the Elastic Stop Nut Corporation of America, 2330 Vauxhall Road, Union, N. J.

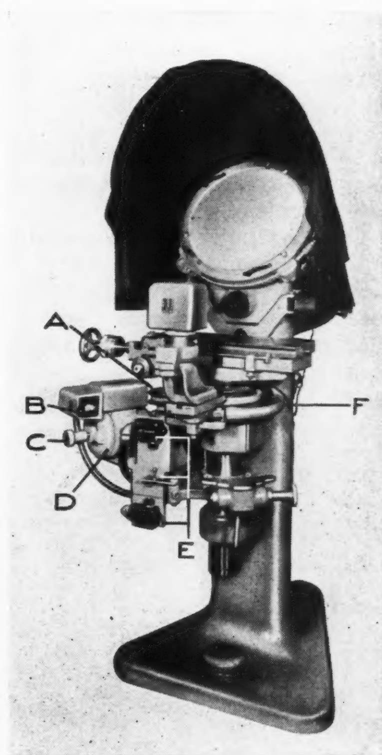
The channel strip is made of high strength 24S-T4 aluminum alloy which gives additional strength for unusual assemblies in such applications as access covers and panels, especially in aircraft, where misalignment of subassembly components can result in nuts being pushed out or in twisted channel strips. A new method of cut and raised dimpling retains the nuts securely and prevents over-riding. E-84

Lincoln Electrode Designed for High-Speed Production

A new mild-steel E6012 electrode, known as "Fleetweld 72," is being introduced by the Lincoln Electric Co., Cleveland 1, Ohio, for high-speed production of single-pass fillet and lap welds in the flat or horizontal positions. This electrode operates best, without overheating, at currents above those normally used with E6012 electrodes. It is available in 14- and 18-inch lengths and in the following diameters: 1/8, 5/32, 3/16, 7/32, 1/4, and 5/16 inch. It will operate on alternating or direct current. E-85

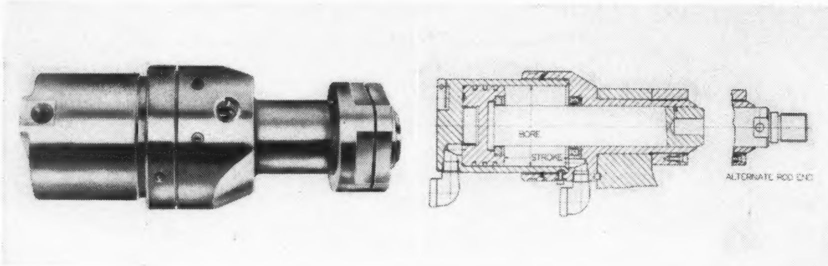
Power Elevating Attachment for Jones & Lamson Optical Comparators

A simple motor-drive unit for raising or lowering the work-table of the pedestal type comparators made by the Jones & Lamson Machine Co., Springfield, Vt., has been developed. As shown in the illustration, a 1/3-H.P. motor *D* with a vertical drive operates a friction drive pulley *A* in contact with the handwheel. A



Motor-drive unit for raising and lowering work-table on Jones & Lamson pedestal type optical comparators

To obtain additional information on equipment described here, use Inquiry Card on page 215.



"Hy-Power" hydraulic cylinder for limited-space and high-pressure applications. Cross-sectional view shows details of construction

safety guard *F* keeps the operator's hands away from the handwheel, and automatic limit switches *E* prevent over-travel. A single switch lever *B* provides control of the rapid acting vertical traverse, and directly below this lever is a manual control knob *C* for final adjustments. E-86

Hannifin High-Pressure Hydraulic Cylinders

Hannifin Corporation, 1110 S. Kilbourn Ave., Chicago 24, Ill., is now offering a standardized line of hydraulic cylinders built especially for "push" stroke applications using up to 5000 pounds per square inch pressure. Designated the "Hy-Power" line, the cylinders are intended for use in combination with the Hannifin "Hy-Power" generator, which supplies pressure up to 1000 pounds per square inch for "approach" and "return" strokes, and then automatically multiplies the pump pressure by five for the power stroke.

These cylinders are especially suitable for use where space is limited and high output force is needed, as in many riveting, punching, and pressing operations. They are available in nine sizes ranging from 2 to 7 1/4 inches bore diameter, with strokes up to 6 inches. Output force on "push" applications ranges from 7 1/2 to 100 tons with 5000 pounds per square inch hydraulic pressure on the head end of the piston....E-87

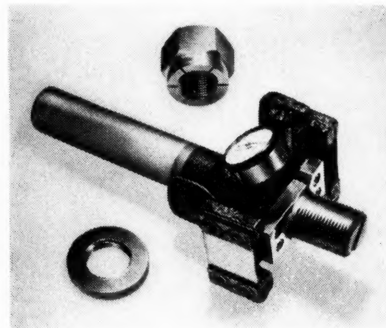
Allen Dial-Feed Table

The A. K. Allen Co., 495 Wythe Ave., Brooklyn 11, N. Y., has brought out an air-operated dial-feed table that can be set up quickly for four-, six-, eight-, or twelve-station indexing by using interchangeable baffle plates. The table can also be set up for twenty-four-station indexing without a baffle plate.

The indexing mechanism consists primarily of an air-operated piston with rack attached; a gear driven by the rack; a pawl mounted on the gear; and a 24-tooth indexing plate on which baffle plates can be mounted to control the engagement of the pawl with the teeth of the index-plate as required for the number of indexing stations to be used. A rod projecting through the case moves outward about 1/2 inch after each indexing movement, and can be used to actuate a valve or micro-switch for controlling secondary operations while the table remains stationary. E-88

Bryant Improved Internal Thread Gage

The Bryant Chucking Grinder Co., Springfield, Vt., has redesigned its portable internal thread gage. This gage is used for the inspection of internal threads from 5/16 to 1 inch, in diameter, either National Coarse or National Fine. In principle, the gage functions as a split plug gage. The plug is collapsed by a thumb-lever, inserted into the threaded hole, and then allowed to

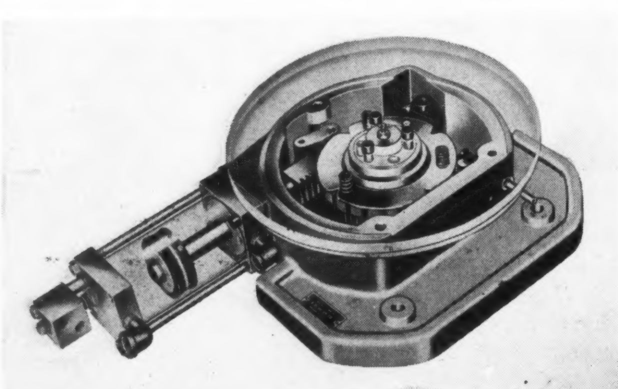


Bryant improved portable internal thread gage

expand. The apparent size of the thread is shown on a dial indicator. Interchangeable segments can be purchased to cover a wide range of thread sizes. These segments all fit the handle mechanism. The new gage is 50 per cent lighter than the previous model, weighing about 14 ounces....E-89

Midget Magnetic Coolant Separator

To insure a consistently clean coolant and provide the best operating conditions for small honing, grinding, and threading



Air-operated dial index-plate made by the A. K. Allen Co.

Magnetic coolant separator developed by Barnes Drill Co.

To obtain additional information on equipment described here, use Inquiry Card on page 215.

machines, the Barnes Drill Co., 820 Chestnut St., Rockford, Ill., has developed the No. 00 "Barnesdril" magnetic coolant separator here illustrated, which has a capacity of 1 1/2 gallons per minute. This separator is small and compact, and can be placed in the coolant storage tank to remove metal particles and fused abrasive from the work. The constant removal of the "load" provides a clean coolant supply which insures obtaining a precision finish that is free of scratches at a faster production rate. E-90

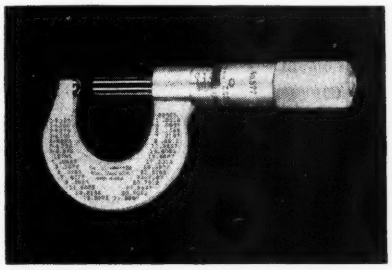


Fig. 1. Starrett micrometer with rounded anvil

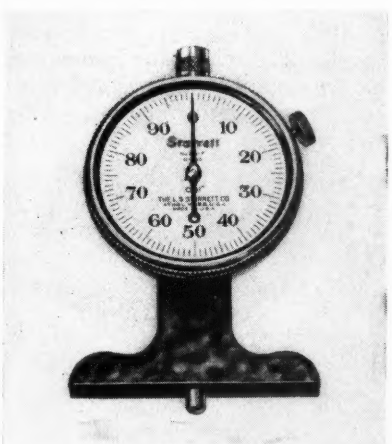


Fig. 2. Starrett dial depth gage for measuring depth of holes, slots, and recesses from 0 to 3 inches deep

Starrett Micrometer with Rounded Anvil and Starrett Dial Depth Gage

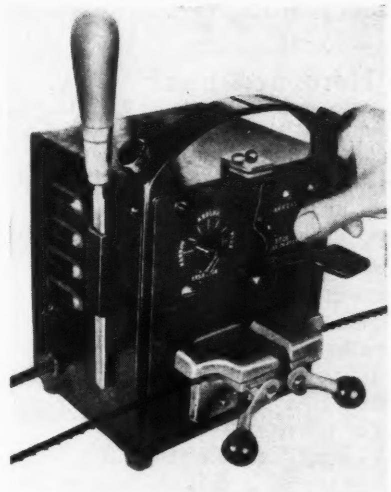
The micrometer shown in Fig. 1, a new product of the L. S. Starrett Co., Athol, Mass., has a rounded anvil which makes it possible to measure, in thousandths of an inch, the wall thickness of tubing, half bearings, full bearings, and various cylinders with walls up to 1 inch thick and inside diameters down to 3/8 inch.

The frame, as well as the thimble and sleeve of this No. 577 model, has a rust-resistant satin chrome finish, which makes markings stand out sharply. Decimal equivalents are stamped on the thimble, and graduations can be quickly read, with every thousandth numbered. The one-piece spindle has hardened threads, ground from the solid.

The dial depth gage seen in Fig. 2, is designed for measuring the depth of holes, slots, recesses, etc., ranging from 0 to 3 inches deep. To use this gage—designated the No. 644—the flat base is positioned on the top surface of the work, allowing the rod to enter the hole or recess to its full depth. The measurement automatically registers directly on the dial in 0.001-inch increments. The base is 2 1/2 inches long by 1/2 inch wide, and is hardened, ground, and lapped within close limits. E-91

Westinghouse "Life-Linestarter"

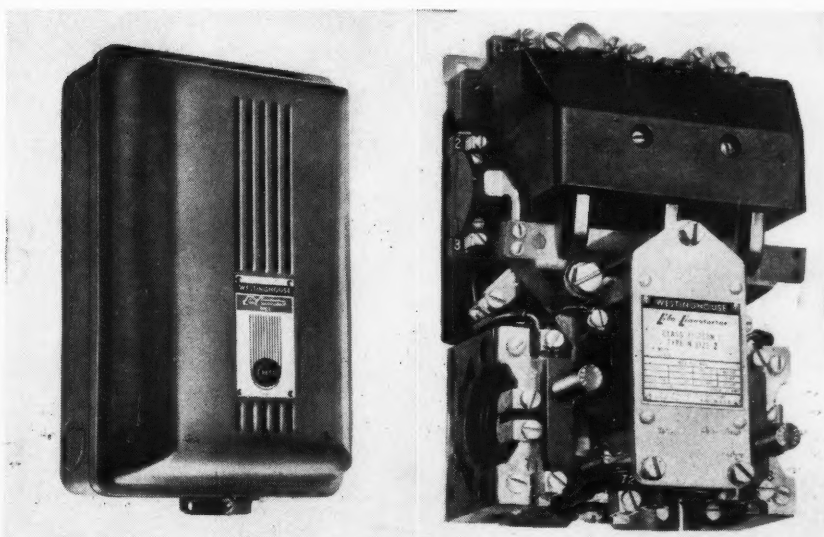
An alternating-current, magnetic, non-reversing De-ion "Life-Linestarter" is now available from the Westinghouse Electric Corporation, P. O. Box 2099, Pittsburgh 30, Pa. It is designed for across-the-line starting of squirrel-cage induction motors or as a primary switch for wound-rotor induction motors. The new line-starter is obtainable in NEMA sizes 0 through 4, and can be applied to all integral-horsepower motors up to 100 H.P. E-92



DoAll portable, automatic saw-blade welder

DoAll Portable Butt-Welder

A portable, automatic saw-blade welder for band sawing machines is announced by the DoAll Co., Des Plaines, Ill. Weighing only 25 pounds, it permits "on-the-spot" welding and annealing of saw blades up to 1/2 inch in width. With this welder, saw blades can be joined to fit any size machine, eliminating brazing and the usual delay in repairing broken bands. Band sawing machines equipped with the new welder can be used for internal sawing operations, as the blade can be rewelded at the machine after being passed through the work. E-93



New Westinghouse "Life-Linestarter." View at left shows heavy sheet-steel enclosure, while view at right shows the Size 2 starter without enclosure

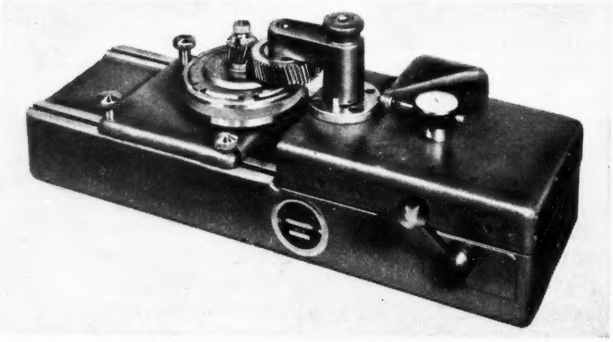
To obtain additional information on equipment described here, use Inquiry Card on page 215.

Electronic "Drill" for Cutting Hardened Steel

The "Electron drill," developed by the Elox Corporation of Michigan, 740 N. Rochester Road, Clawson, Mich., employs an entirely new electronic principle of operation, which increases the speed of cutting hardened steels as much as fifteen times over previous models.

Using an electrode in place of a drill, it can be employed for removing broken tools or producing holes in hardened metals. The process will not affect the material being worked on—that is, it will not either anneal or harden the work-piece. In addition to being applicable to hardened steels, it can be used for cutting carbides, non-ferrous materials, such as aluminum, copper, and zinc, and many other materials. "Drilling" is a continuous process for the full length of the electrode.

The "Electron drill" has a nominal 2-KVA rating, and will operate on any 110-volt, 60-cycle lighting system. E-94



Improved design of "Red Ring" gear rolling fixture made by National Broach & Machine Co.

"Red Ring" Gear Rolling Fixture

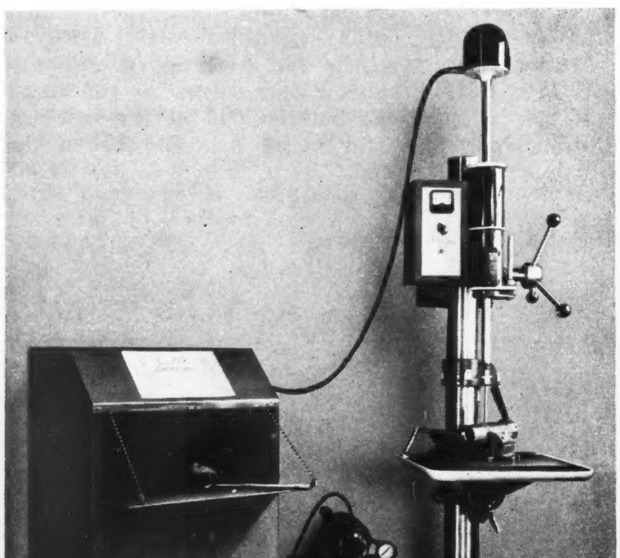
The "Red Ring" rolling fixture for checking gears, recently announced by the National Broach & Machine Co., 5600 St. Jean Ave., Detroit 13, Mich., facilitates loading and unloading the work-gear and enables larger and more complicated assemblies to be checked by the gear rolling method, which immediately indicates any errors in both size and eccentricity and serves as a check of excessive tooth roughness.

The illustration shows the low sun gear and clutch assembly for an automatic transmission being inspected. The work is carried on the head at the left-hand end of the fixture, which is adjustable for gears of varying diameter. The master gear, used to check the sun gear, is held by a swinging head mounted on the precision ball slide carriage shown at the right. When the carriage is retracted by the hand-lever, the swinging head can be lifted and swung clear of the work-gear for loading and unloading.

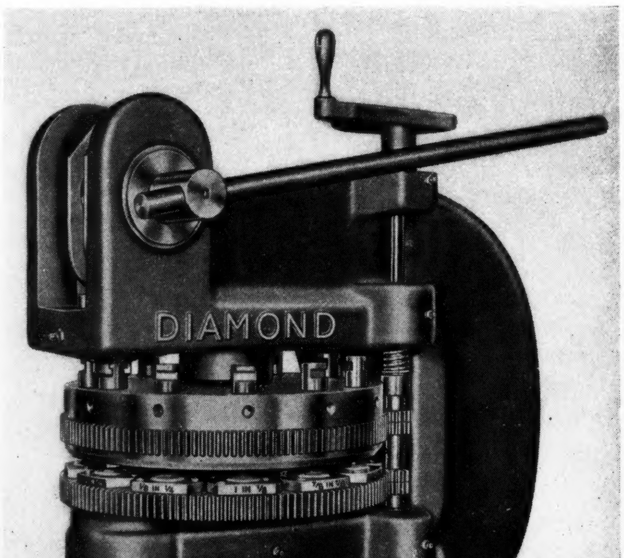
The inspection is made by advancing the carriage to bring the master gear and work-gear into mesh. The gears are held in contact by a constant predetermined spring pressure and rolled together. Errors are registered on a dial indicator. E-95

Hand-Operated Turret Punch Press

The Diamond Machine Tool Co. of 3425 E. Olympic Blvd., Los Angeles 23, Calif., has announced the development of a hand-operated turret punch press. This

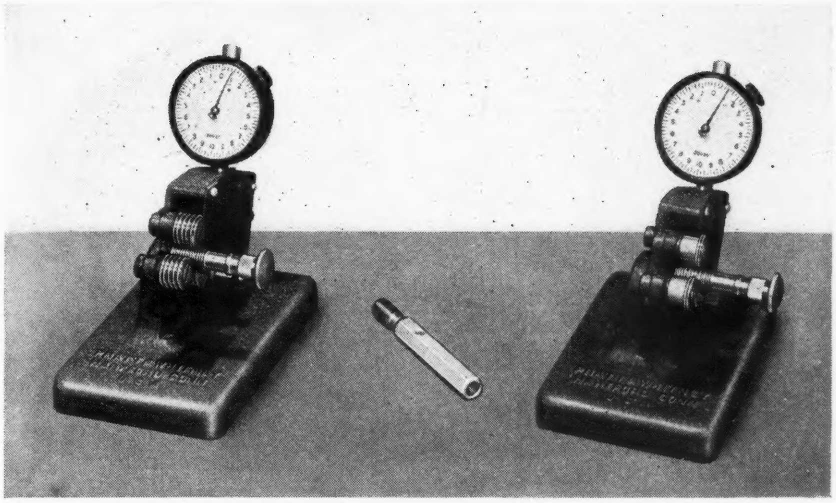


Electronic "drill" developed by the Elox Corporation for high-speed cutting of hardened steels



Turret punch press equipped with twelve punches and dies, built by Diamond Machine Tool Co.

To obtain additional information on equipment described here, use Inquiry Card on page 215.



"Tri-Roll" comparator for checking external threads made by Pratt & Whitney. The view at the right shows device equipped with two-rib rolls for testing pitch diameter only

machine greatly reduces the cost of piercing, embossing, or forming parts in quantities less than 500, as there are no dies to make or set up.

The press has a 13-inch throat, and contains twelve punches and dies, any of which can be brought under the ram for immediate use by turning a handle. Its capacity is 10 tons, and the maximum punch size, when operating on 1/8-inch mild steel, is 1 1/2 inches. E-96

Wysong & Miles Power Squaring Shears

Adding to its line of sheet-metal squaring shears, Wysong & Miles Co., Greensboro, N. C., has introduced a new line of 16-gage power squaring shears in cutting lengths of 42, 52, 72, 96, and 120 inches. To insure accurate cutting, the bed is squared with the end frames in all three directions. Ways for hold-down and knife-bar travel are accurately machined from steel and hand-scraped for perfect bearing, so that the travel is true.

A "non-repeat" unit is built into the clutch, and it can be set for single-stroke or continuous shearing. The back gage is the ball-bearing precision type, with an adjustment to 0.0078 inch, effected by turning a handwheel. To aid in positioning sheets and to provide an accurate measure from the cutting edge, adjustable stainless-steel scales are embedded in the table. Hold-down action is automatic. E-97

Pratt & Whitney "Tri-Roll" Thread Comparator

Rapid and accurate checking of male threads is made possible by the new "Tri-Roll" thread comparator now being produced by Pratt & Whitney Division Niles-Bement-Pond Co., West Hartford 1, Conn. Externally threaded parts to be measured are cradled between two stationary gaging rolls, and a third roll, mounted on a preloaded armature, is swung into contact. A dial indicator, graduated in increments of 0.00025 inch, gives cumulative readings of errors in lead, angle, and pitch diameter.

Gaging rolls are form-ground in a series of annular ribs, as shown in the view at the left. When a check on pitch diameter only is desired, rolls with only two ribs, as shown in the view at the right, are used. These ribs are truncated to a 3/8-pitch flat on their major diameter and cleared in their minor diameter. With two-rib rolls, the device can be used for checking the pitch diameter of three-fluted taps.

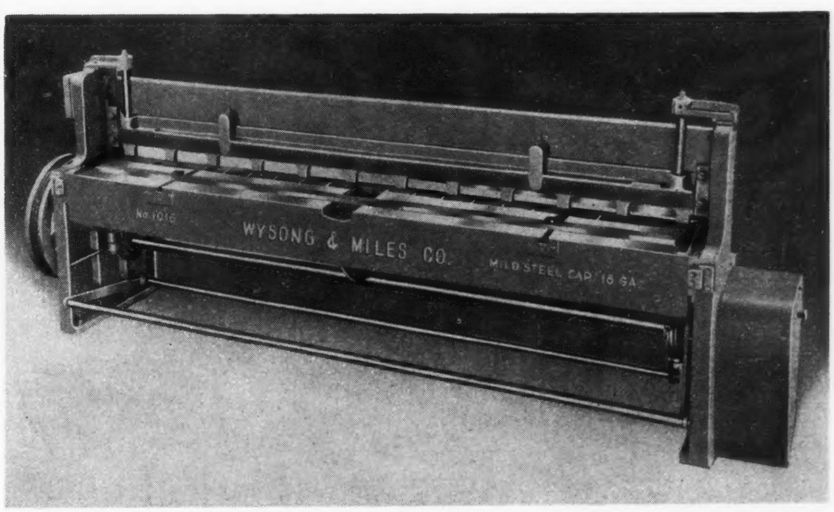
Initial setting is established with a setting plug, after which the exact amount of deviation over or under size in threaded parts is registered on the dial. Thus Classes 1, 2, 3, 4, and 5 American National Threads or Classes 1A, 2A, and 3A Unified Threads can be checked from the same initial setting.

Within the range of each gage, the gaging rolls can be changed with ease for another diameter or pitch. The rolls rotate freely, minimizing contact surface wear, and can be reground should they become slightly worn. By transposing the two bottom rolls in the comparator, either right- or left-hand threads can be checked.

Because of its three-point contact principle, the "Tri-Roll" is self-cleaning, permits unobstructed visual inspection, and readily detects out-of-round conditions and dented threads. E-98

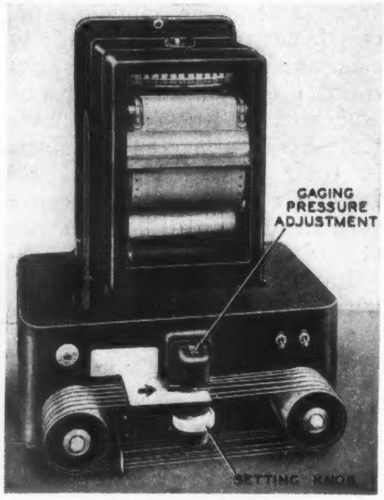
American Optical Co.'s New Respirator

The American Optical Co., Southbridge, Mass., has announced a new twin cartridge respirator, which provides protection against low concentrations of organic vapors and all dusts. E-99



Power squaring shear recently added to the line of Wysong & Miles Co.

To obtain additional information on equipment described here, use Inquiry Card on page 215.

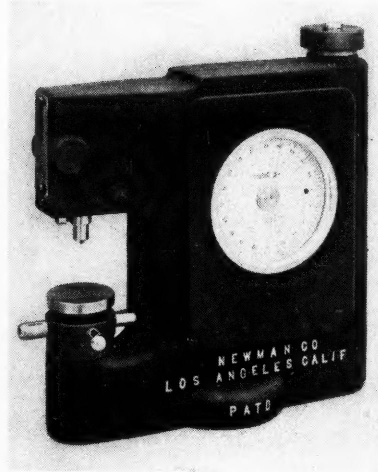


P & W Micrograph for Inspecting Strip Materials

"Micrograph" comparator, designed to inspect a cross-section of continuous strip materials, such as cellophane, vinyl plastics, and thin papers. A 2-inch wide piece of material, cut out across the width of the strip, is placed lengthwise on the indexing feed mechanism, and the instrument then automatically indexes the material, taking a reading every 1/4 inch and recording the thickness on a chart. This record can be laid across the continuous strip material to afford an accurate production control graph of thickness variation across the width. Made by Pratt & Whitney Division Niles-Bement-Pond Co., West Hartford 1, Conn. E-100

Interchangeable High-Speed Steel Punches

One of a complete line of standardized interchangeable high-speed steel round punches introduced by Richard Brothers Division, Allied Products Corporation, 12677 Burt Road, Detroit 23, Mich., to supplement the company's established line of round tool-steel punches. The new punches are carried in stock in the same size ranges as the tool-steel line. They incorporate the R-B interchangeable feature, in which a ball-bearing lock in the retainer engages a ball seat on the punch shank, providing secure positioning both radially and vertically. This design permits instant insertion or removal of either the punches or dies. E-101

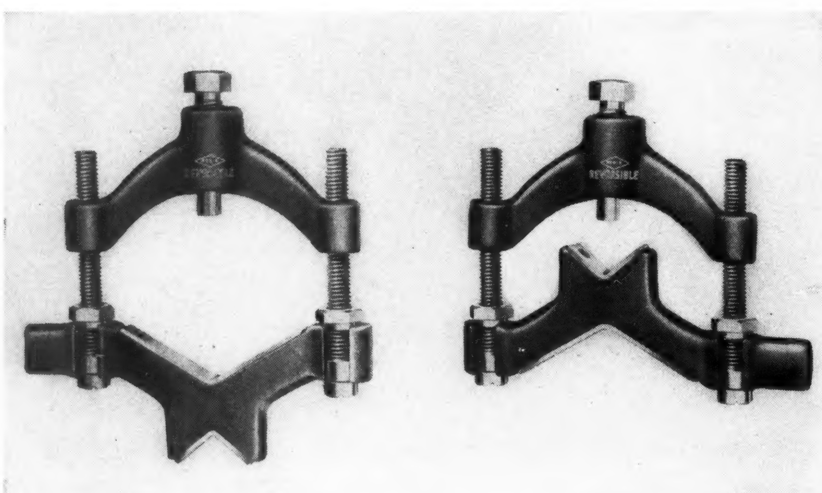


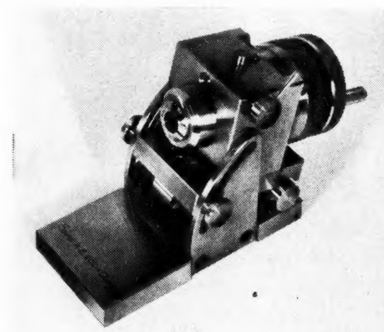
Newman Portable Precision Hardness Tester

Portable precision hardness tester brought out by the J. P. Newman Co., 3544 E. Fowler St., Los Angeles 33, Calif. Designed for Rockwell type hardness measuring in the C, B, and E scales. All other scales are covered by a transposing chart. The throat opening is 1 1/2 inches. The over-all size of the tester is 9 by 9 inches, and it has a 3-inch base. The weight is 4 1/2 pounds. E-103

Reversible-Jaw Work-Driving Dog for Cylindrical Grinder

Drop-forged steel dog for driving work on cylindrical grinder. Made by Ready Tool Co., 550 Iranistan Ave., Bridgeport, Conn. This dog is available in five sizes to accommodate work of any diameter from 1/4 inch to 6 inches. The V-plates on the reversible jaw and the tip on the clamping screw are made of brass to prevent marring the work. The dog is accurately balanced, and can be used on any make of cylindrical grinding machine. E-102

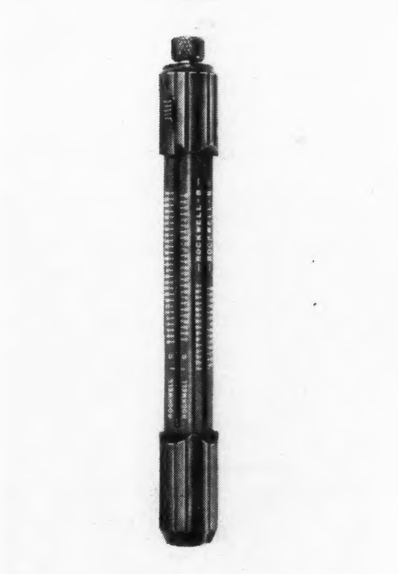




Precision Master Grinding Attachment

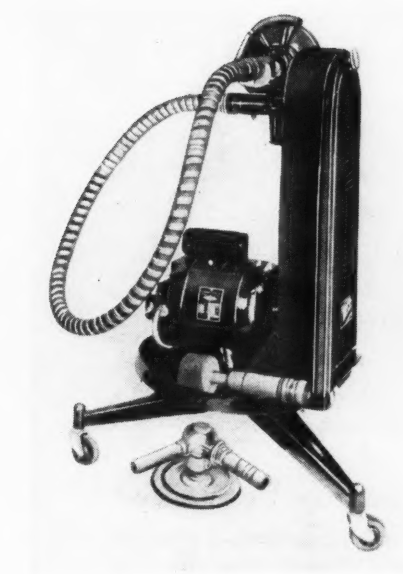
Master grinding attachment designed for single set-up grinding of flats, cylindrical surfaces, grooves, radii, longitudinal slots, and eccentric-shaped parts. Also adapted for use in jig boring, light drilling, milling, tapping, and inspection work. A sine-plate facilitates angular settings from 0 to 45 degrees with an accuracy of plus or minus 0.0001 inch. Dividing head accuracy for twelve positive positions is 1 minute, and 2 1/2 minutes for visual settings by vernier. Collet capacity is 0 to 1/2 inch. Over-all dimensions are 7 1/2 by 3 3/4 by 4 3/4 inches, and weight 12 pounds. The attachment is manufactured by the Star Gauge Co., 261 Oak Grove Ave., Springfield 9, Mass. E-104

To obtain additional information on equipment described here, use Inquiry Card on page 215.



Pocket-Size Hardness Testing Instrument

"Metalometer" pocket-size surface hardness testing instrument introduced by Peabody Industries, Inc., 1863 Penobscot Building, Detroit 26, Mich. This instrument of patented design is precision-checked. In operation, it is placed on the surface to be checked and a hammer is released. Accurate readings are available almost instantly on any of the three standard scales—Brinell, Rockwell B, and Rockwell C. E-105

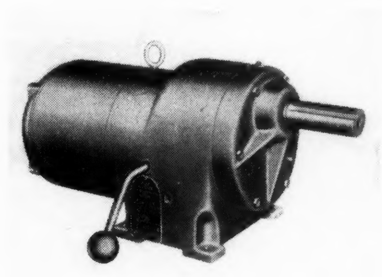


Flexible-Shaft Machine with Enclosed Drive

Wyco "Lo-Gravity" flexible-shaft machine with fully enclosed drive, brought out by Wyzenbeek & Staff, Inc., 841 W. Hubbard St., Chicago 22, Ill. Spot- and arc-welded steel stampings are used in the construction of the machines of this new line to obtain strength and light weight. The motor is placed low on the tripod base of the machine to provide stability. Any motor of suitable horsepower can be used. There is a locking clamp on top of the machine for holding the "handpiece" firmly when stationary grinding is to be done. E-107

Feedall Automatic Hopper Feed

Automatic self-contained hopper feed developed by Feedall Machine & Engineering Co., 29 Elm St., Willoughby, Ohio. A selector ring, driven by a fractional-horsepower motor, rotates through the work, which is selected and fed from the under side of the ring, thereby achieving the selection and feeding of the part in one operation. This unit is particularly adapted for feeding flat cylindrical work, such as washers, nuts, bearing races, stampings, etc. It is suitable for use with assembling presses, welding machines, and second-operation machines. ..E-108

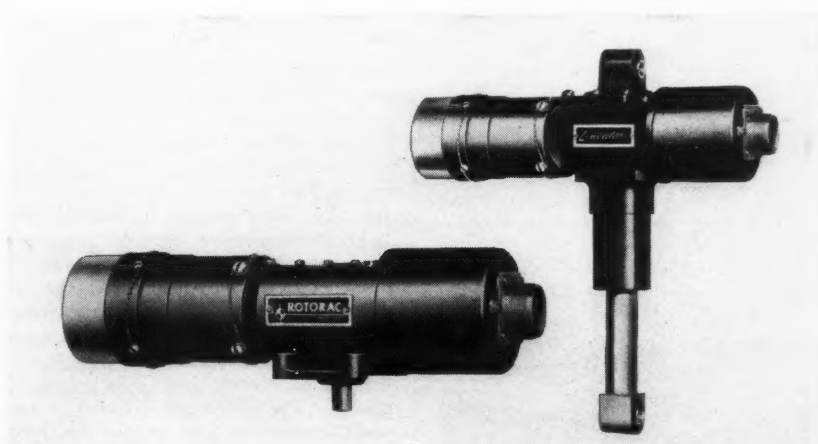


Lima Selective-Speed Gearshift Drive

Heavy-duty selective-speed gearshift drive recently added to line of Lima Electric Motor Co., Dept. AB3, Lima, Ohio. This Type R3C drive has a combination integrally mounted electric motor and a four-speed transmission with both primary and secondary gear reductions. Especially adapted for motorization of automatic screw machines. All units have primary selective gear ratios of 4.15, 3.15, 1.85, and 1 to 1. The eleven secondary gear ratios range from 2.25 to 1. With a motor having a full load speed of 1730 R.P.M., the low, second, third, and high speeds give forty-four output speeds ranging from 186 to 1730 R.P.M. E-106

"Rotorac" and "Lineator" Actuators for Industrial Applications

Industrial Model "Rotorac" and "Lineator" electric rotary and linear actuators, recently modified for operation on 110-volt, 60-cycle, single-phase alternating current, in addition to the low-voltage direct current for which they were originally designed. This change eliminates the need for a rectifier and greatly increases their adaptability for industrial applications. Made by Airborne Accessories Corp., 25 Montgomery St., Hillside 5, N. J. E-109



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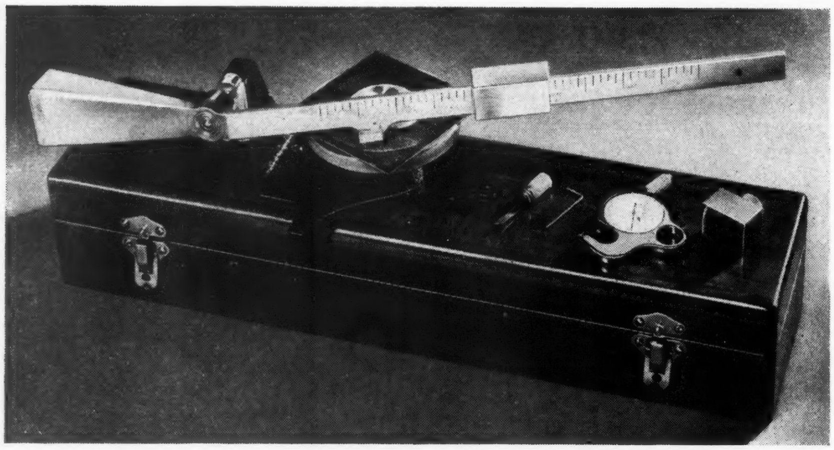
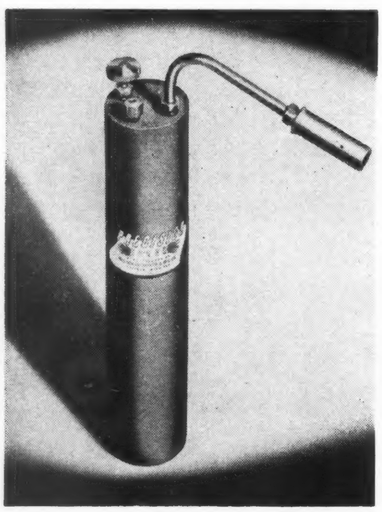


Device for Testing Abrasion Resistance

New Model 140 abraser, developed by Taber Instrument Corporation, 111-M Goundry St., North Tonawanda, N. Y., for testing abrasion resistance of solid materials and coated surfaces. This device incorporates the rotary "rub wear" action of dual abrading wheels having criss-crossing paths. The action is continuous throughout the 360-degree rotation of the specimen, and closely parallels abrasive wear encountered in actual use. Different type wheels are provided for hard and soft materials and resilient materials. E-110

Torch for Light Soldering and General Heating Operations

Butane-propane gas torch, known by the trade name "Precision" torch, developed by the Precision Engineering & Mfg. Co., 280 Center St., Saginaw, Mich. It weighs only 4 pounds, fully loaded, and is capable of generating heat up to 2200 degrees F. No hoses, tanks, or moving parts of any kind are required. The torch is designed for light brazing, soft and hard soldering, and all other general heating operations. Its features include a gas filter for high combustion efficiency, a burner shield to prevent wind from disturbing the flame, a universal tip, and finger-tip control of the pressure valve that permits changing from a pin-point size flame to a large one. E-111

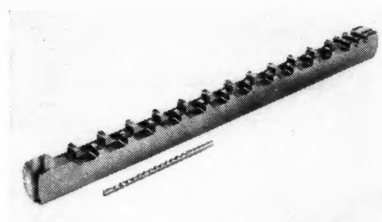


General Electric Photo-Electric Eyes

A new standard line of accessories for photo-electric relays, consisting of a complete range of improved light sources and photo-tube holders, available at greatly reduced prices, was announced recently by the General Electric Co., Schenectady 5, N. Y. The light sources have simple "snap-on" covers that make possible lamp replacement in about twenty seconds. In addition, pre-focussed lamps are used throughout, assuring that the filament is in the proper position in relation to the transmitting lens of the light source. The photo-tube holder is furnished complete with photo-tube, lens, masks, and connecting cable. The new accessories can be applied with photo-electric relays for counting, signalling, limiting, controlling, or protecting installations. E-112

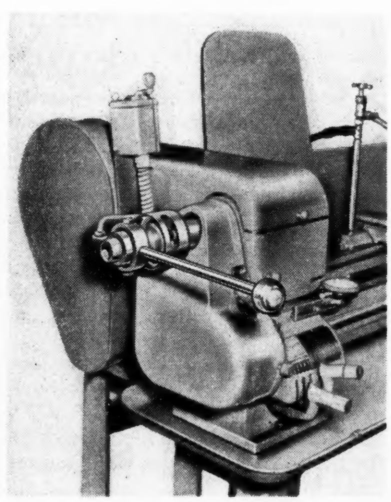
du Mont Keyway Broaches

"Minute Man" keyway broach for cutting large size keyways—7/8 and 1 inch—shown in comparison with a 1/16-inch broach. The large broaches are equipped with staggered teeth to provide ample chip room for heavy cuts in long bores, and the cutting teeth are ground with a sufficient number of chip-breakers to reduce the amount of pressure required to push the broach through the bore. The shank end of the large broaches is provided with a 1/2-inch reamed hole for quick locating and alignment of an extension shank. A shank is furnished with each broach. Made by the du Mont Corporation, Greenfield, Mass. E-113



"Waltco" Quick-Opening Collet Attachment

"Waltco" quick-opening collet attachment placed on the market by the Bell Equipment Co., 5212 Santa Fe Ave., Los Angeles 58, Calif. Developed to meet the demand for low-priced production type collet attachment with a 1-inch capacity for lathes having spindle holes 1 3/8 inches in diameter. This attachment can be installed on any lathe in a moment without disconnecting the gear guard. E-114



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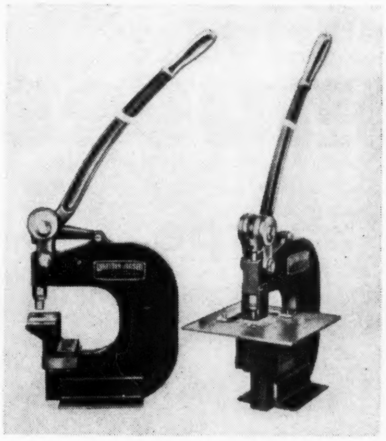
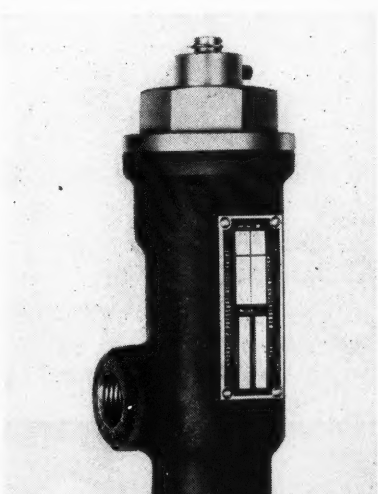


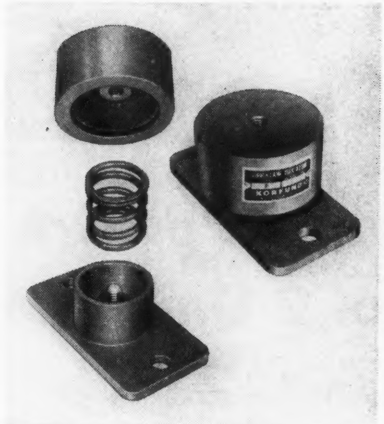
Whitney-Jensen Bench Punch

Hand-operated bench punch with a throat depth of 7 inches and a throat height of 5 inches manufactured by Whitney Metal Tool Co., Rockford, Ill. The high, deep throat of this No. 18 punch makes it well adapted for a wide range of punching applications. It is of the roller-bearing lever type, and can be furnished with a work-table 10 by 10 inches in size having 1/4-20 tapped holes for locating side and back gage-bars. Round holes up to 13/16 inch diameter can be punched through 12-gage mild steel. E-115

Precision Hydraulic Relief Valve

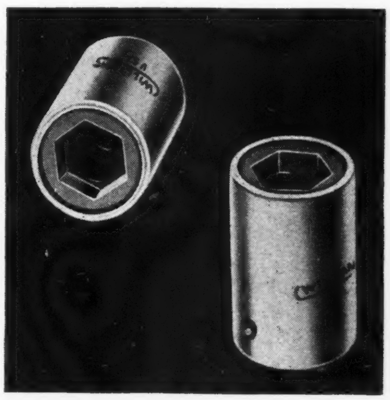
New cartridge type hydraulic relief valve announced by the Hydraulics Division, Pantex Mfg. Corporation, Pawtucket, R. I. This valve meets Government standards as set up by Specification AN-V-1b for Army and Navy aeronautical use. It is available for pressure settings ranging from 100 to 5000 pounds per square inch. The valve opens and closes within a 7 per cent differential. E-116





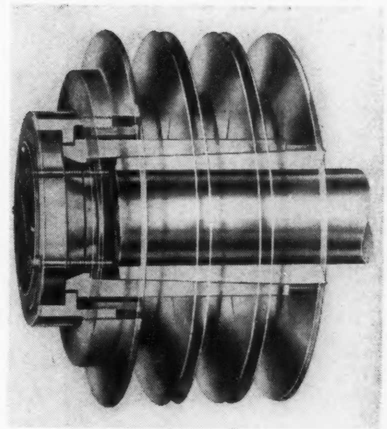
Heavy-Duty Spring Mounting

New low-cost vibration isolator mounting available from the Korfund Co., 48-39-M 32nd Place, Long Island City 1, N. Y. This mounting is adapted for use in the installation of pumps, compressors, fans, engine-generator sets, and other equipment. The unit provides vertical thrust control, as well as sound insulation. Furnished with several standard spring capacities for loads ranging from 10 to 500 pounds per isolator. Suitable for mobile or stationary installations. E-117



Self-Tapping Screw Sockets with Carboloy Inserts

Examples of a new line of "Impact Supersockets" for driving casehardened, self-tapping screws with power tools of all types, developed by J. H. Williams & Co., 400 Vulcan St., Buffalo 7, N. Y., with the cooperation of the Carboloy Company, Inc. The screw-drive opening in these sockets is formed of solid Carboloy, which is permanently inserted into a hardened steel blank. The Carboloy surfaces are said to have increased the life of the sockets tenfold. These sockets are available in 1/4-inch square drive with 1/4- and 5/16-inch nominal hexagon openings. Both size sockets fit hexagon-washer and oval-hexagon-washer heads. E-118

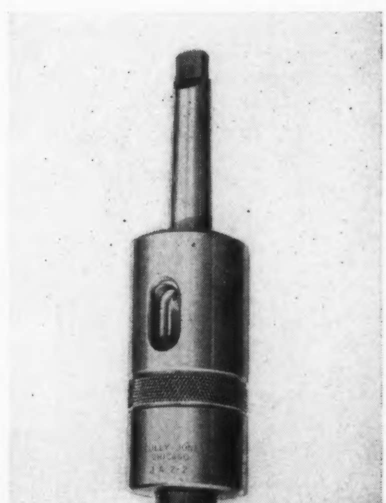


Double-Taper Adjustable-Diameter Sheave

New adjustable-diameter V-belt sheave with taper bushing and taper sleeve on which the flanges are mounted. Announced by the American Pulley Co., 4200 Wissahickon Ave., Philadelphia 29, Pa. This double-taper hub feature, in addition to providing for easy mounting and dismounting of the sheave, is designed to lock the unit rigidly into a single solid sheave, thereby eliminating vibration, wear, and corrosion. E-119

Scully-Jones Floating Tool-Holder

Floating tool-holder brought out by Scully-Jones & Co., 1901 S. Rockwell St., Chicago 8, Ill. The principle employed is the same as that used to compensate for misalignment between shafts. A double gear or spline-drive coupling is utilized to give unrestricted parallel or angular float for accurate tapping, reaming, and similar operations. Any misalignment between the tool and the work is instantly corrected by the floating action. E-120

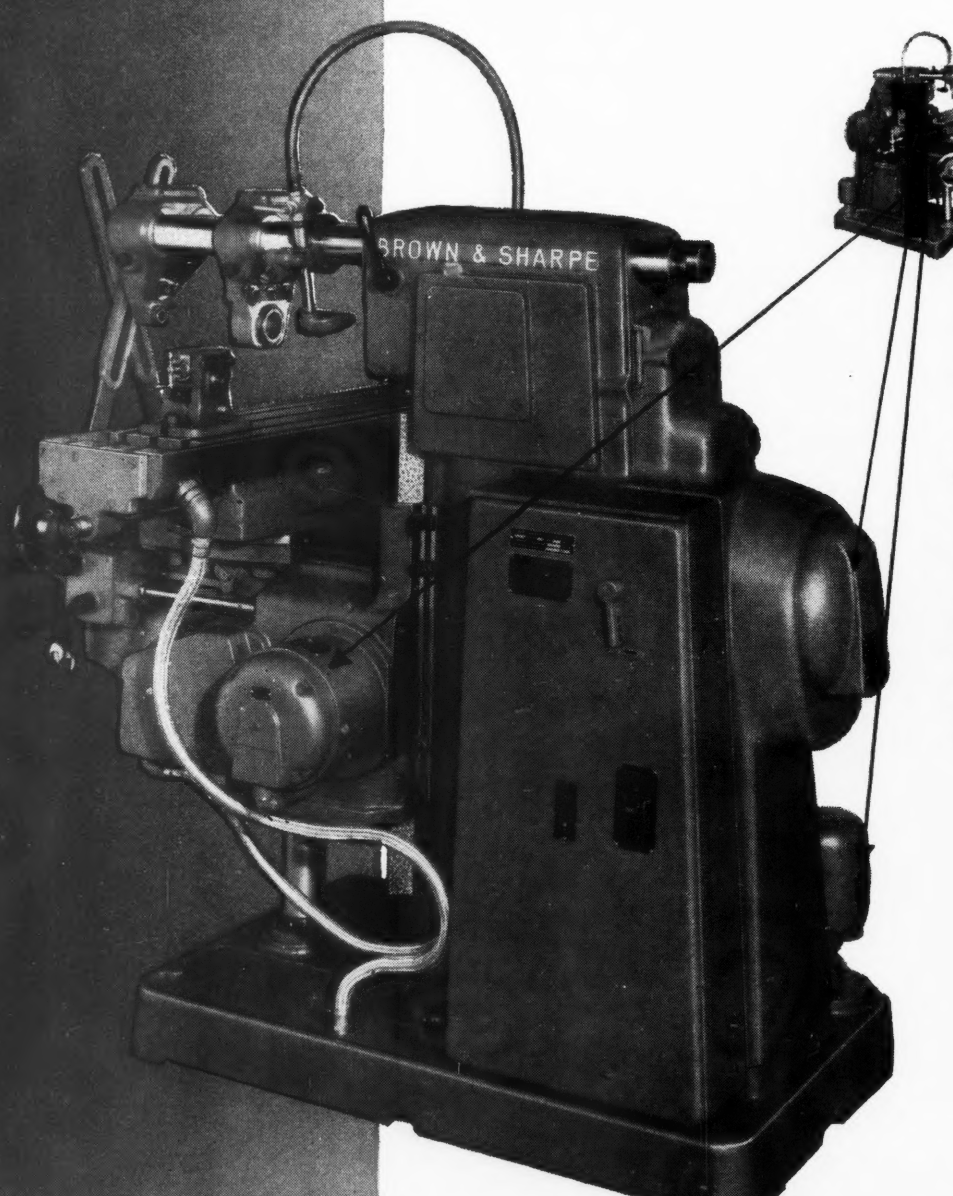


To obtain additional information on equipment described here, use Inquiry Card on page 215.

LONG-ESTABLISHED

User-Bonuses

in Brown & Sharpe No. 2 Universal and No. 2 Plain Milling Machines

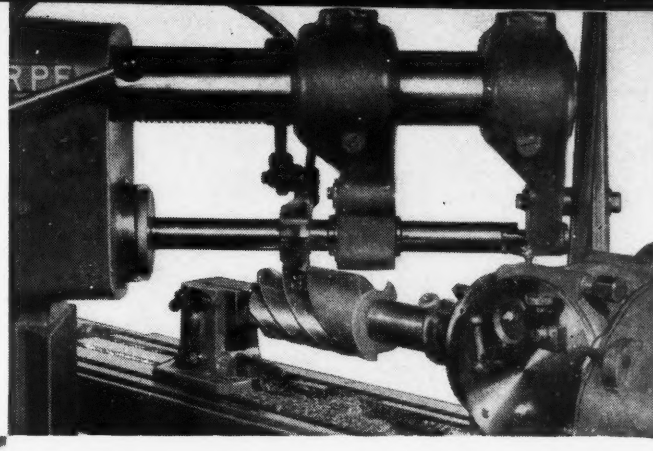


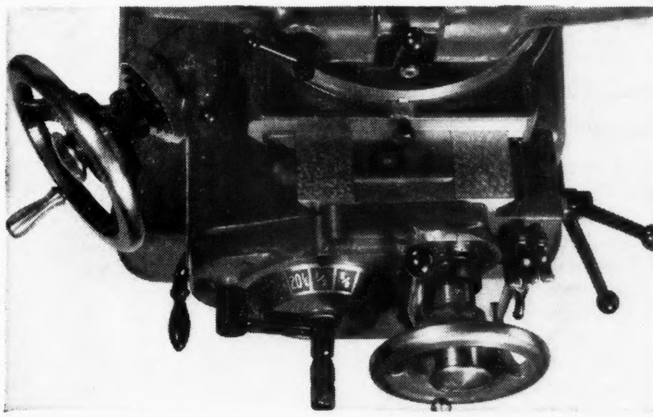
TRI-MOTOR DRIVE
for efficiency —
No clutch needed

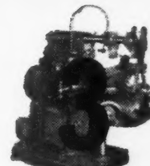
3 individual driving motors . . . for spindle, table and coolant . . . advantageously placed, save loss of power within machine. Independent spindle motor assures full power for driving cutter. Feed motor coordinated with spindle driving motor . . . thus start-stop lever controls not only spindle motor but entire machine. All-gear drive.

BROWN &

EXTENDED SPINDLE FACE for added clearance, greater rigidity of cutter support Giving added clearance for work and fixtures, this distinctive feature reduces cutter and arbor vibration. Front spindle support is closer to center of table where cutters are most frequently used. Hence, cutter is mounted closer to spindle nose . . . an essential to maximum cutter rigidity under working loads.

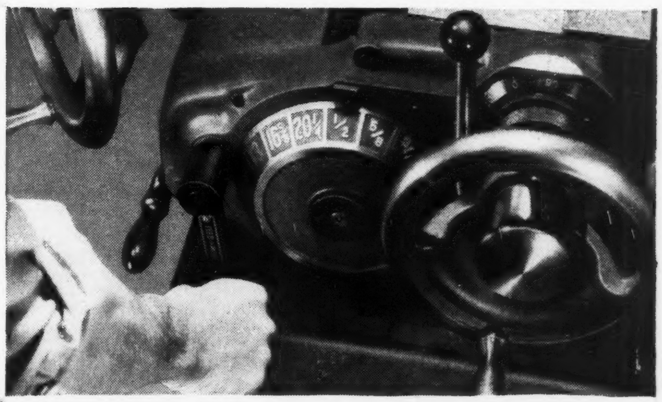


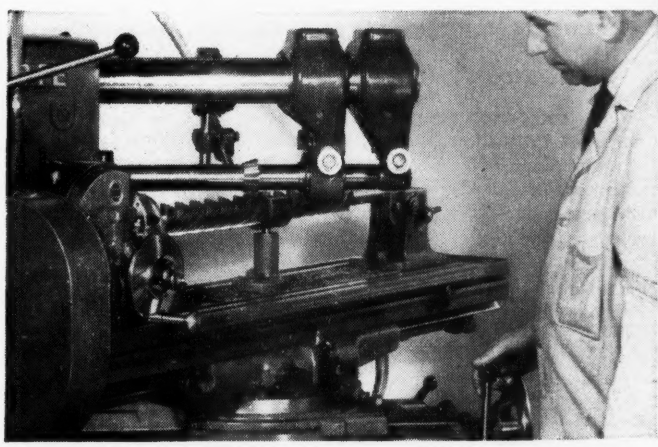


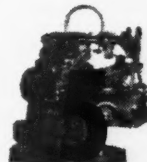


TIME-SAVING CONTROLS speed production Convenient, fan-like arrangement of all operating controls promotes ease and efficiency of operation. Other features include . . . feed control levers that are directional; longitudinal lever that cannot be engaged when table is clamped; vertical adjustment by handwheel for steady hand feed; fast travel available with spindle rotating or stopped.

18 FEEDS — 18 SPEEDS quickly obtained Choice of feed rates in range where majority of work is milled . . . 14 of the 18 under 10″ per minute. Ease of selection prompts operator to change to most productive rate as frequently as conditions warrant. 18 changes of speed give suitable cutting speeds . . . from small end mills to face mills . . . on a wide variety of materials.







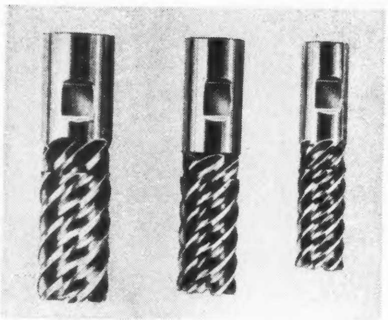
FAST TRAVEL AND FEED, same in all directions Uniform feed rates (longitudinal, transverse and vertical) with uniform 75″ per minute power fast travel in direction of feed engaged . . . do not require doubling or halving rate to get same surface finish when changing direction.

These typical features best illustrate the progressiveness in design of Brown & Sharpe Milling Machines. All are built into the No. 2 Universal and No. 2 Plain Machines, 3 and 5 horsepower; and except for the extended spindle face, into the No. 2 Vertical Milling Machines, 3 and 5 horsepower, also. See how these design features can speed up your milling operations.

Brown & Sharpe Mfg. Co., Providence 1, R. I., U. S. A.

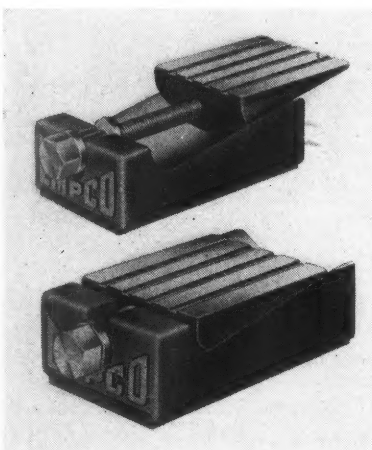
SHARPE

B·S



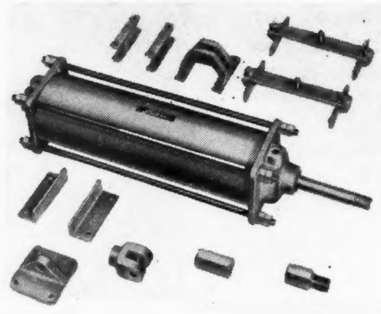
Shear-Cutting Type End-Mills

Shear-cutting type end-mills designed to apply the rotary broaching principle. These end-mills have their helical cutting edges at an extremely large angle to the axis of rotation so that they remove metal with a true shear-cutting action. They are ground from the solid after having been hardened to 63 to 65 Rockwell C. An extremely deep counterbore on the cutting ends permits resharpening many times before these cutters are worn out. They can be easily resharpened on any tool or cutter grinder without the use of special fixtures. Product of the Shearcut Tool Co., P. O. Box 746, Reseda, Calif. E-121



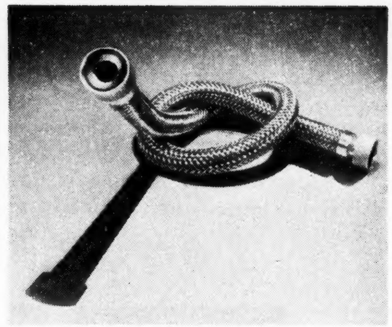
Machine Leveling Jack with Vibration Absorbing Mounting Pads

New machine leveling jacks with vibration absorbing mounting pads. The vibration absorbing material "Vi-Sorb," of which the pads are made, was developed for use under heavy loads to eliminate creepage and reduce machine maintenance costs due to vibration. These jacks are 2 inches high, 6 inches long, and 3 1/2 inches wide. A "Turn-O'-Screw" leveling feature saves time in installing and in releveling. Announced by Enterprise Machine Parts Corporation, 2731 Jerome Ave., Detroit 12, Mich. E-122



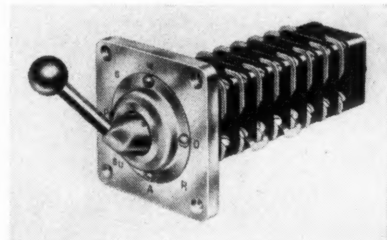
Ledeen Air and Hydraulic Cylinders

A new line of air and hydraulic cylinders, known as the "Medium Duty Series," has been announced by Ledeen Mfg. Co., 1600 S. San Pedro St., Los Angeles 15, Calif. These cylinders are a recent addition to the line of heavy-duty and super-duty cylinders manufactured by this company for a wide range of remote control and clamping operations. Various head and rod attachments meet the mounting requirements for any application. E-123



Flexible Stainless-Steel Hose

Corrosion-resistant flexible stainless-steel hose manufactured in several types by the Chicago Metal Hose Corporation, 1304 S. Third Ave., Maywood, Ill. This hose will withstand high temperatures and pressures up to 2000 pounds per square inch, and is made for conveying corrosive liquids and gases. Fabricated in sizes from 5/16 inch to 6 inches inside diameter, single or multiple ply. E-124

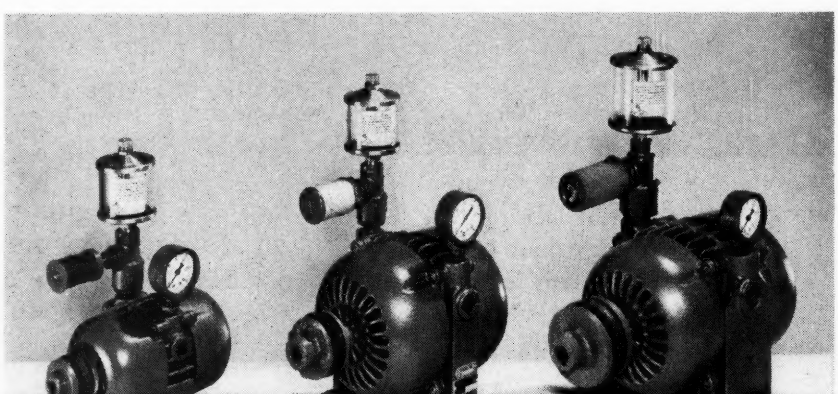


Arrow-Hart Push-Pull Selector Switch

Push-pull selector switch developed by the Arrow-Hart & Hegeman Electric Co., 103 Hawthorn St., Hartford 6, Conn., to provide a single point of control for a multiple-operation machine. Any combination of momentary contact elements can be arranged to serve in place of push-buttons, relays, and contactors for starting or stopping a machine. E-125

Rotary Compressors and Vacuum Pumps with Improved Housings

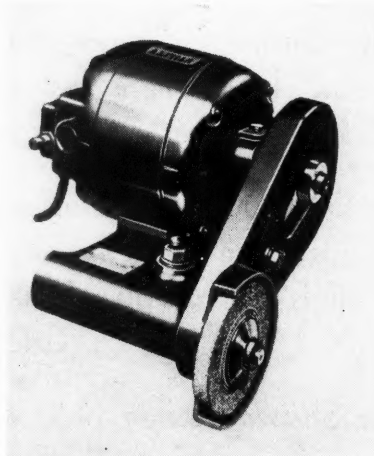
Heavy-duty pumps and compressors with housings of improved streamline design brought out by the Gast Mfg. Corporation, Benton Harbor, Mich. Although the new housings are lower in height and of more compact design than preceding models, they have the same mounting dimensions, and are interchangeable with the earlier designs. The cooling fins are made integral with the housing for more efficient dissipation of the heat. E-126



To obtain additional information on equipment described here, use Inquiry Card on page 215.

Dumore Toolpost and Bench Grinder

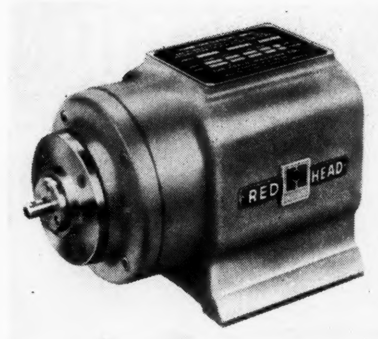
Dual-purpose toolpost and bench grinder announced by the Dumore Co., Racine, Wis. This 1/4-H.P., 5000-R.P.M. grinder is accurate to 0.0002 inch. It fits lathes of 9- to 13-inch swing for external cylindrical grinding, cnd can be mounted on a shaper, planer, or milling machine for surface grinding. When not needed for preci-



sion work, it can be quickly converted to bench use for burring castings, cleaning welds, tool sharpening, etc. The unit is available for use on both 110- and 200-volt 60-cycle alternating current. E-129

"Gardsman" Furnace Temperature Controller

"Gardsman" Model J controller announced by Taco West Corporation, 525 N. Noble St., Chicago 22, Ill. Designed primarily for the control of furnace temperatures, but equally well adapted for the control of torque, pressure, and vacuum in various types of industrial and laboratory equipment. One application is in plastic molding and extrusion machines. E-127

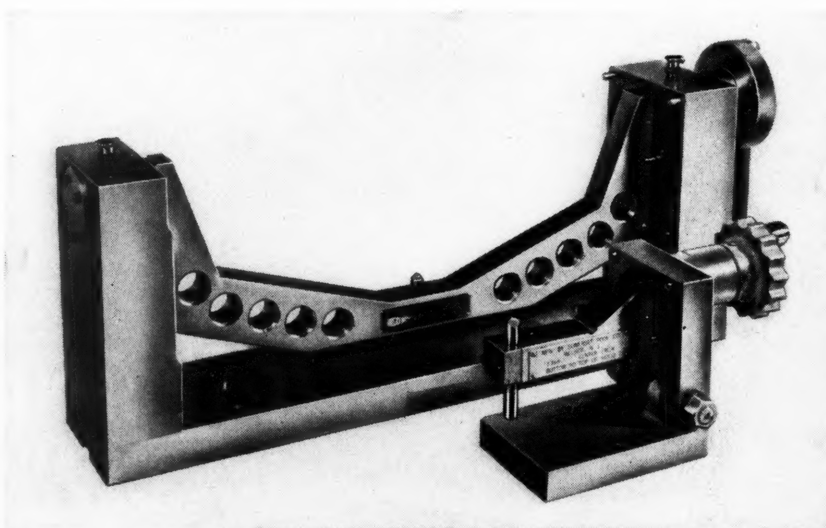


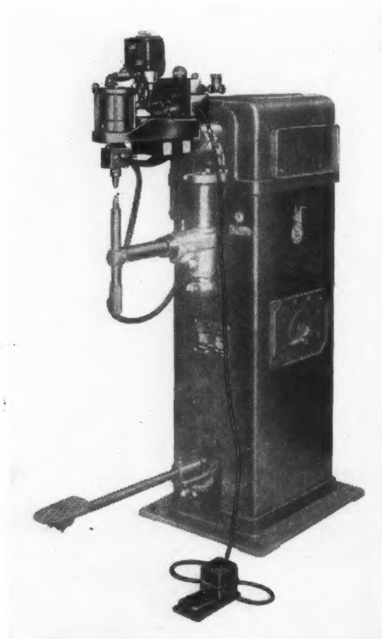
Heald "Hi-Frequency Red Heads" for High-Speed Small-Hole Grinding

One of a new line of wheel-heads for high-speed small-hole grinding brought out by the Heald Machine Co., Worcester, Mass. These new "Hi-Frequency Red Heads," as they are called, are available in eight different models, covering a range of 6000 to 100,000 R.P.M., and in a complete range of sizes ordinarily required for such work. The two smallest heads have a combined range of 45,000 to 100,000 R.P.M., and are arranged to take mounted point wheels. The higher speed heads are designed to take care of requirements for high-speed grinding of small holes beyond the limits of conventional belt-driven heads, and provide surface speeds heretofore unavailable with standard type heads. E-130

Somerset Special Grinding Wheel Radius Dressers

Large-size special grinding wheel radius dresser made to suit customer's individual requirements by the Somerset Tool Co., 220 Virginia St., Hillside, N. J., shown in comparison with smaller standard size dresser built by company. The new units are so designed that the grinding wheel is dressed from below, making the operation easy to see. This also eliminates the necessity of removing the wheel guard. The larger model has been built for dressing wheels up to 18 inches in diameter and 4 inches face. This special radius dresser also has the stop-pins used in the standard dressers. E-131

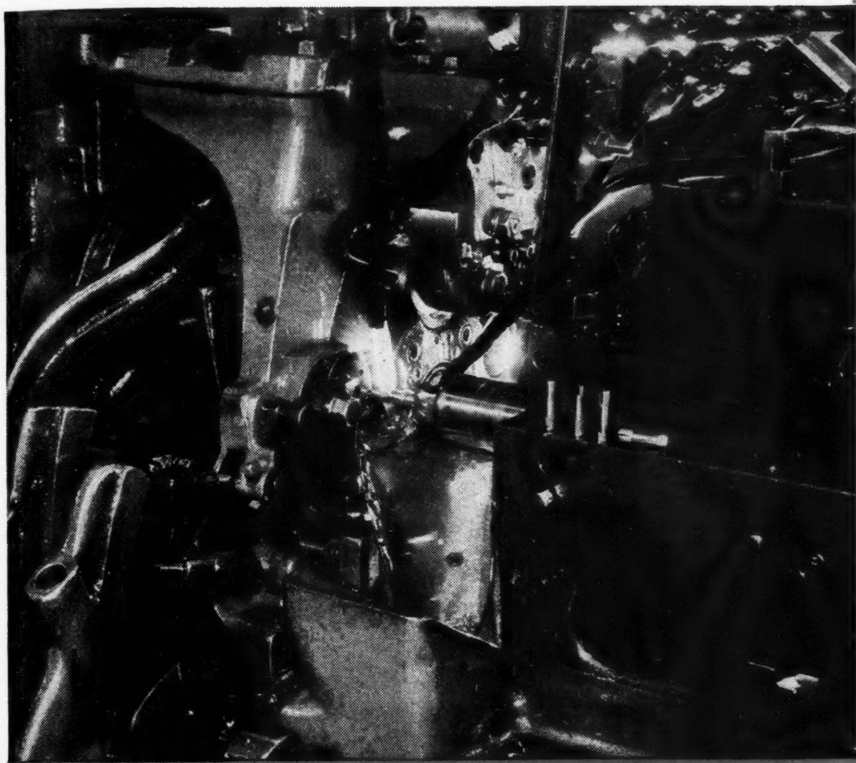




Spot-Welders Equipped with "Weld-Air-Matic"

Small, self-contained air-operated "Weld-Air-Matic" attachment manufactured by the Robert W. Hoffman Co., Inc., 32 S. Clinton St., Chicago 6, Ill. Designed for clamping to upper horn of conventional foot-operated rocker-arm spot-welders. This welding unit operates on a reduced air pressure of 15 to 50 pounds. It has a maximum stroke of 1 1/2 inches on Size 1 welders, 2 inches on Size 2, and 2 1/2 inches on Size 3 welders. Designed to operate in conjunction with any standard weld timer control. E-128

To obtain additional information on equipment described here, use Inquiry Card on page 215.



PART

Over-all length	1"
Stock Diameter	5/16"
Slot	1/4" deep x 5/16"
Head	5/16" dia. x 5/16" long
Small Diameter	1/4" x 23/32" long
Milled Flats	5/32" wide on 23/32" dia.

TOOLING

Davenport 5-spindle Model B

1st position	Form and Support
2nd position	Size (shaving tool) and Support
3rd position	Mill slot (Slotting saw 965 r.p.m. 2¼", 560 s.f.p.m.
4th position	Mill flats and Support
5th position	Radius, chamfer, cut-off (Cut-off tool .0025" feed)

DATA

Material	B-1113
Cycle	3 seconds
Spindle Speed	1930 r.p.m.

875 MORE PIECES  **per 8-hr. shift**

This TEXACO user* also reduces unit costs two other ways

When *Texaco Cleartex Cutting Oil* was placed in service as the coolant on this job, the better cooling and lubrication that resulted showed up quickly in the reduced number of necessary tool grinds.

On the slotting saw, for example, four regrinds in 24 hours were reduced to three. Cut-off tool life was extended from two to six hours. In addition to these worth-while savings in regrinding costs, reduction in down-time enabled the machine to produce an extra 875 pieces per 8-hour shift.

These two factors—increased production and reduced tool maintenance—add up to lower unit costs.

Let a Texaco Lubrication Engineer specializing in machining operations help you make savings in your plant. *Texaco Cleartex Cutting Oil* is only one of a complete line of Texaco Cutting, Grinding and Soluble Oils designed to help you do your machining better, faster, and at lower cost.

Just call the nearest of the more than 2,000 Texaco Wholesale Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

**Name on request*

TEXACO REG. T. M.

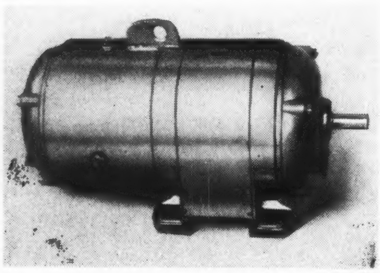
TEXACO CUTTING, GRINDING AND SOLUBLE OILS FOR FASTER MACHINING

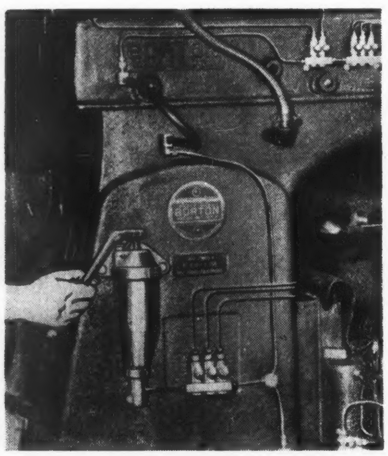
For more information on products advertised, use Inquiry Card, Page 215

inch over their full length. Lightweight hollow construction makes them easy to grip and carry with the work from machine to bench. E-139

High-Frequency Alternators

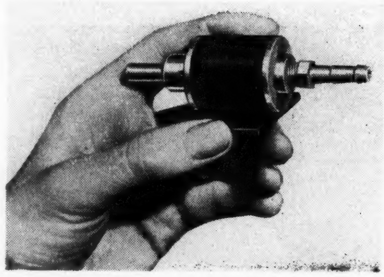
Single- or three-phase homopolar inductor alternator with electronic exciter regulator designed to provide voltage regulation of plus or minus 1 per cent, equipped with new low-slip induction motor component to keep frequency within plus or minus 1/2 per cent. Can be used as a power supply for electronic equipment, such as radar, X-ray machines, calculators, induction heating machines, etc., and for motor drives on high-speed machine tools and instruments. Available in sizes up to 10KW, with frequencies up to 1500 cycles. Made by American Electric Motors, Inc., 4811 Telegraph Road, Los Angeles 22, Calif. E-140





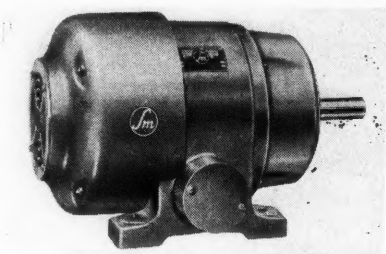
Lincoln "CentrOiler" Pump

Master oiler, known as the "CentrOiler," brought out by the Lincoln Engineering Co., 5798 Natural Bridge Ave., St. Louis 20, Mo., for lubricating a number of bearing points on machine tools. The "CentrOiler" pump supplies lubricant through a single line circuit of SL-4 injectors, which, in turn, deliver a predetermined, measured quantity of oil to each bearing at every cycle. E-141



Miniature Air Cylinders

"Micro" miniature air cylinder for use in operating clamps in small jigs and fixtures. This air cylinder, despite its small size, delivers a 75-pound thrust on line pressure of 100 pounds per square inch. Uniform ram pressure is exerted throughout the 5/8-inch stroke. Any number of cylinders can be operated by a single control valve. The cylinders are machined from solid brass bar stock. Made by Air-Mite, 2651 W. Lake St., Chicago 12, Ill. E-142

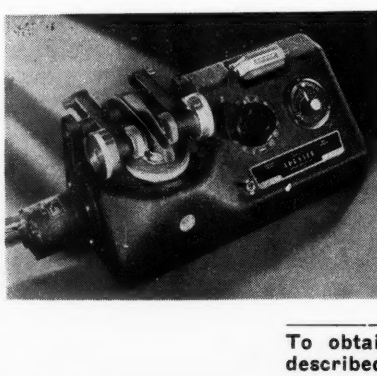


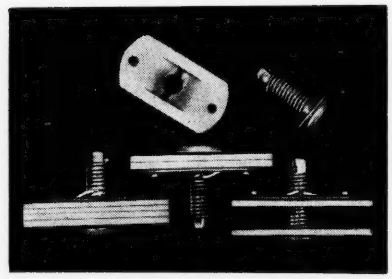
"Klosd-Tite" Fan-Cooled Motor

"Klosd-Tite" fan-cooled motor built by Sterling Electric Motors, Inc., Los Angeles 22, Calif., which is now available with face-mounted end bracket having NEMA Style C dimensions, in ratings of 3/4 to 20 H.P., inclusive. Obtainable in either the footless type or standard horizontal type with feet. The face-mounted motors are especially adapted for close-coupled pumps or blowers or for building into a machine as an integral part. E-143

Shear Hardness and Diamond Scratch Tester

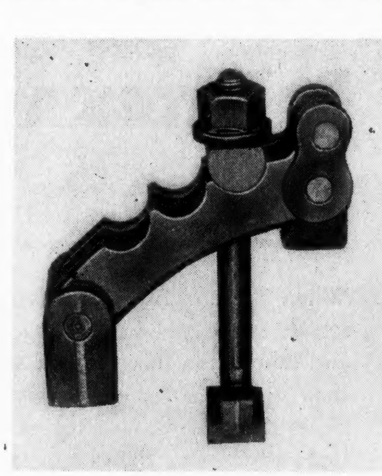
Shear hardness and diamond scratch tester for the precision testing of plastic materials and plastic coated surfaces in order to determine their resistance to scratches and similar physical damage not classed as normal wear. Designed to measure accurately the surface toughness and the scratch resistance. Both tests are performed with a finely balanced scale beam calibrated in grams, to which is attached a precision-ground contour shear tool or diamond-point scratch tool. Announced by Taber Instrument Corporation, 111-M Goundry St., North Tonawanda, N. Y. E-144





"Southco" Vibration-Proof Fastener

Vibration-proof "Southco Spring-Grip" fastener made by the South Chester Corporation, 1403 Finance Building, S. Penn Square, Philadelphia 2, Pa., which is claimed to be so designed that it will not loosen under the most severe vibration or panel movement. It employs a spring as a thread, which acts as a shock absorber and cushions vibration and panel movement. E-145



C & S Universal Clamps

Clamp brought out by Carroll & Shipley Machine Tool Products, Inc., 720 W. Twelfth St., Anderson, Ind., which has been designed to eliminate the need for blocking and shimming. The tool-room model shown has a special front foot and stop-pin adapted for clamping round bars held in V-blocks and for clamping on a narrow ledge, sloping surface, rough casting, or smooth surface. Also made in regular model, with plain pivoted flat foot and no stop-pin, for ordinary machine table clamping. E-146

To obtain additional information on equipment described here, use Inquiry Card on page 215.

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PRODUCTION CURVES ARE RISING...

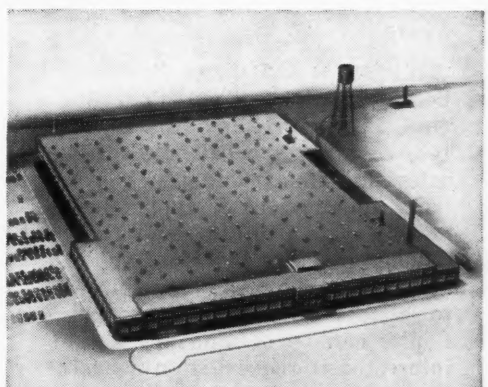
...at AMERICAN'S New Plant at WILLIMANTIC

4-WINGED DRIVER CAN'T SLIP OUT OF PHILLIPS TAPERED RECESS

Like a giant new ship on its "shakedown cruise"...when the officers and crew learn their new duties . . . and the machinery begins to synchronize . . . *then things really begin to move!*

And that's the situation, now, at American's new plant in Willimantic, Connecticut. Acres of the newest and fastest automatic machines are steadily boosting the production curves of both American Phillips and Slotted Fasteners . . . and the quality curve, as well.

This modern, streamlined plant will soon be one of the top-production units of the screw industry . . . deliveries expedited by national distribution which is now geared up to greater efficiency than ever before.



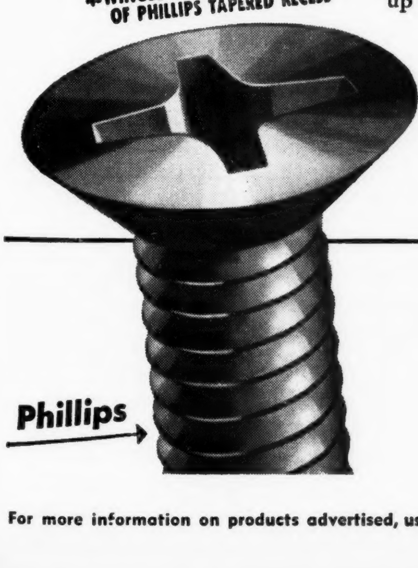
Willimantic production and shipments will be supplemented by our Norristown, Pennsylvania, plant and Chicago, Illinois, warehouse.

AMERICAN SCREW COMPANY

Plants at Willimantic, Conn. & Norristown, Pa.

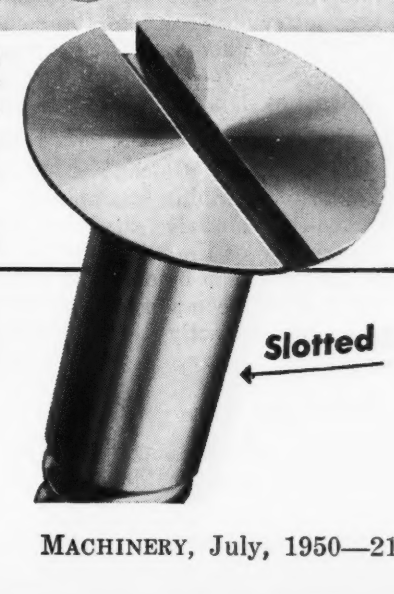
Warehouses at:

589 E. Illinois St. Chicago 11 — **502 Stephenson Bldg. Detroit 2**



Phillips

AMERICAN SCREWS



Slotted

For more information on products advertised, use Inquiry Card, Page 215

New Trade Literature

RECENT PUBLICATIONS ON MACHINE SHOP EQUIPMENT, UNIT PARTS, AND MATERIALS

To obtain copies of these publications, fill in identifying number at end of descriptive paragraph on Inquiry Card, page 215, or write directly to manufacturer, mentioning catalogue described in the July, 1950, number of MACHINERY.

Cold-Drawn Steels

REPUBLIC STEEL CORPORATION, ADVERTISING DIVISION, 3100 E. 45th St., Cleveland 27, Ohio. Booklet entitled "Furnace Treatment of Republic Union Cold-Drawn Steels," (Adv. 452), completing a series of five booklets on cold-finished products. Types of modern furnaces used in heat-treating carbon and stainless bar steels are described, and different heat-treating processes are discussed. Booklets can be obtained if requested on a company letter-head, directed to the corporation.

Interchangeable Punch System

WHITMAN & BARNES DIVISION, UNITED DRILL & TOOL CORPORATION, Plymouth, Mich. Catalogue 103, covering the expanded Hercules interchangeable punch system. Illustrations of applications of this system to dies built for a number of stamping plants show how the system can be adapted to almost any pierced product. Copies can be obtained by those interested if requested on a business letter-head sent to the company at the address given above.

Abrasive Disks

METAL REMOVAL CO., 1014 N. Ashland Ave., Chicago 22, Ill. Folder containing samples of "Pres-On" abrasive disks and a description of the "Pres-On" trial kit. Copies can be obtained if requested on a company letter-head, addressed directly to the Metal Removal Co.

Tools and Dies

DIE SUPPLY CO., 5349 St. Clair Ave., Cleveland 3, Ohio. Catalogue 5, containing 104 pages on the company's line of tools, dies, and machine shop supplies. Copies will be sent if requested on a business letter-head, addressed directly to the company.

Alloy Steels

JOSEPH T. RYERSON & SON, INC., Chicago, Ill. Circulars describing Ryerson VD steel, a water-hardening, general-purpose steel suitable for shear blades, blanking and forming dies, cutters, etc.; and Ry-Alloy steel, a special-analysis oil-hardening steel adapted for rolls, blanking and forming dies, gages, taps, etc. C-1

Press-Brake Dies

CYRIL BATH CO., 6880 Machinery Ave., Cleveland 3, Ohio. Catalogue containing 48 pages of data on Bath press-brake dies for forming metals to almost every conceivable shape. A section on piercing tooling and tables of tonnages required for various bending and punching operations are included. C-2

Automatic Gear-Checking Recorders

MICHIGAN TOOL CO., 7171 E. McNichols Road, Detroit 12, Mich. Bulletin MTR-50, describing and illustrating the Model MTR Michigan automatic gear-checking recorder for making permanent chart records of involute tooth forms, tooth spacing, leads, contours, thread forms, etc. C-3

Industrial Control Devices

BROWN INSTRUMENTS DIVISION, MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne and Windrim Aves., Philadelphia 44, Pa. Catalogue 8303, containing 64 pages showing over 100 models of pneumatic, electric, and electronic devices for controlling temperature, flow, pressure, liquid level, and humidity. C-4

Carbide-Insert Grinding Fixture

HAMMOND MACHINERY BUILDERS, INC., 1614 Douglas Ave., Kalamazoo, Mich. Bulletin 701, illustrating and describing Hammond solid carbide-insert grinding fixtures for the rapid and accurate grinding of chip-breaker grooves in inserts of various shapes. C-5

Hydraulic Presses

HYDRAULIC PRESS MFG. CO., Mount Gilead, Ohio. Circular entitled "It Takes Big Machines Like These to Make Big Machines," describing how difficult production problems in the manufacture of high-pressure steel pipe was solved by the use of 18,000-ton hydraulic presses. ... C-6

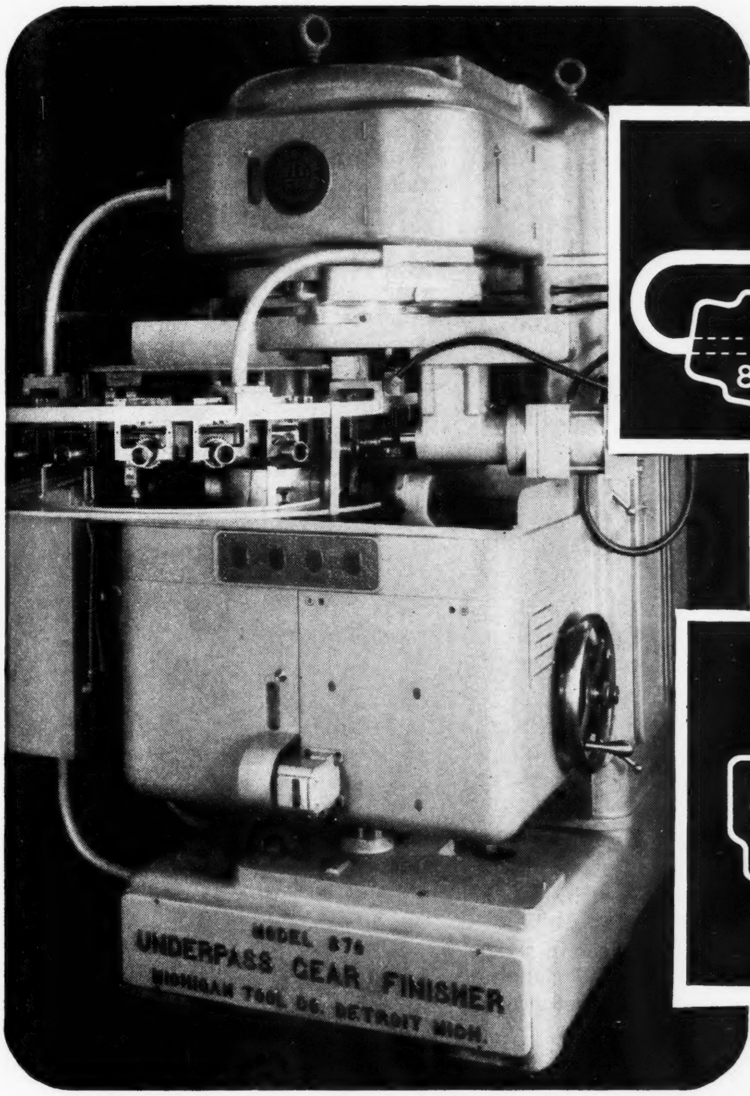
Turret Punch Presses

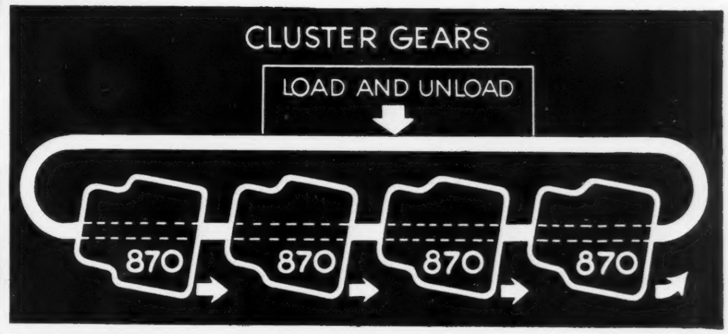
WIEDEMANN MACHINE CO., 4205 Wissahickon Ave., Philadelphia 32, Pa. Bulletin 241, describing the Wiedemann turret punch press for piercing operations, which incorporates the high speed and accuracy of the pantograph for hole location with the time-saving features of the turret design. C-7

Precision Castings

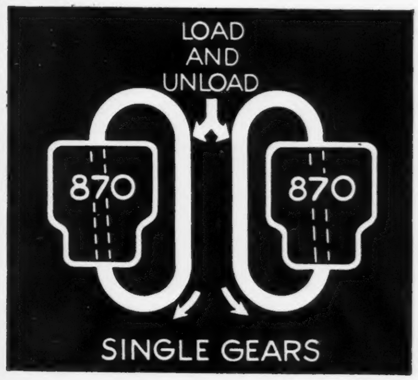
MICROCAST DIVISION, AUSTENAL LABORATORIES, INC., 715 E. 69th Place, Chicago 37, Ill. Booklet entitled "New Horizons with Microcasting," describing many appli-

To obtain copies of these publications, fill in number at end of note on Inquiry Card, page 215.





with conveyorized gear finishers



Michigan CUTS GEAR COSTS *Again!*

Gears can now be finished completely automatically ON A CONVEYOR—without manual or subsidiary mechanical machine loading.

Michigan's improved 870s are now so designed that conveyors can pass right THROUGH THE MACHINE. Each gear stops for a few seconds to be finished—then travels on with the conveyor.

Cycle time on the installation shown here is 17½ seconds for finishing—2½ seconds for conveyor movement between operations—20 seconds per gear TOTAL.

The same conveyor can be passed right through several 870 machines, if desired, to automatically finish all gears on a cluster.

Loading or unloading gears from the conveyor is simplicity itself. The touch of a finger separates the jaws which hold the gear. Remove the finger and the gear is securely supported. Finished gears are removed from the conveyor at any convenient location by the same light finger pressure.

We will be glad to have one of our representatives stop in with a complete set of photos and tell you more about this interesting development. Write to:

COMPLETE
from blank to finished gear
EQUIPMENT

MICHIGAN TOOL COMPANY **7171 E. McNichols Road Detroit 12, U.S.A.**

cations of the precision investment casting or "lost wax" process, including a step-by-step explanation of this process. C-8

Interchangeable Notching Units

WALES - STRIPPIT CORPORATION, 345 Payne Ave., North Tonawanda, N. Y. Catalogue N, illustrating and describing the complete line of Wales self-contained interchangeable notching units for use on stamping presses and press brakes. C-9

Magnetic Chucks

SUNDSTRAND MAGNETIC PRODUCTS CO., DIVISION, SUNDSTRAND MACHINE TOOL CO., 2530 11th St., Rockford, Ill. Booklet covering applications of Sundstrand magnetic "Power-Grip" chucks in tool-room work, general-purpose milling, and production machining. C-10

Machines for Measuring Surface Roughness

PHYSICISTS RESEARCH CO., 321 S. Main St., Ann Arbor 6, Mich. Bulletin describing the company's complete line of Profilometer equipment for measuring the roughness of surfaces produced by machining, grinding, and finishing operations. C-11

Screw Assemblies

EATON MFG. CO., RELIANCE DIVISION, Massillon, Ohio. Engineering folder S-49, on "Springtites" and "Sems" (screw or bolt and washer assemblies), containing information on the new Class 2-A thread fit for screws or bolts, as well as data on slotted, Phillips, and clutch heads. C-12

Air-Turbine Portable Grinders

ONSRUD MACHINE WORKS, INC., 3940 Palmer St., Chicago 47, Ill. Bulletin 1129, illustrating and describing the Onsrud complete line of air-turbine portable grinders, including 1/6-, 1/4-, and 1/2-H.P. sizes, with speeds of 75,000, 50,000, and 38,000 R.P.M., respectively. C-13

Alloy-Steel Chisels

DELAWARE TOOL STEEL CORPORATION, Wilmington, Del. Bulletin 2 SK, describing a new line of "Safe-T-Kut" alloy-steel chisels for hand and pneumatic and electric hammer use, which are made and inspected by processes especially designed to insure safety of operation. C-14

Power Screwdrivers and Motorized Hopper Units

DETROIT POWER SCREWDRIVER CO., 2799 W. Fort St., Detroit 16, Mich. Catalogue covering company's line of screwdriving machines, work-holding fixtures, motorized hopper units, nut-drivers, and assembling machines. C-15

Lubricating Greases

STANDARD OIL CO. (INDIANA), 910 S. Michigan Ave., Chicago 80, Ill. Bulletin AD3084, describing the grades and uses of the new Stanolith water- and heat-resistant lubricating greases, which are applicable to a wide variety of operating conditions. C-16

Pre-Paint Metal Cleaner

OAKITE PRODUCTS, INC., 22 Thames St., New York 6, N. Y. Service Report describing the characteristics of Oakite Compound No. 33 for removing rust and, at the same time, cleaning metal surfaces preparatory to painting. C-17

Centralized Lubrication

FARVAL CORPORATION, 3293 E. 80th St., Cleveland 4, Ohio. Circular entitled "Studies in Centralized Lubrication," containing case studies showing the economies resulting from the installation of Farval centralized lubrication systems. C-18

Electric Rotary Actuators

AIRBORNE ACCESSORIES CORPORATION, 25 Montgomery St., Hillside 5, N. J. Bulletin 112, illustrating and describing the new compact "Trim Trol" electric rotary actuator for industrial applications, suitable for use on either direct or alternating current. C-19

Blast Cleaning

AMERICAN WHEELABRATOR & EQUIPMENT CORPORATION, 19 S. Byrkit St., Mishawaka, Ind. Booklet entitled "The Airless Wheelabrator—What It Is—and What It Will Do," describing various types of blast cleaning machines and their applications. C-20

Keyway Broaches

ZAGAR TOOL, INC., 24000 Lakeland Blvd., Cleveland 23, Ohio. Bulletin 505, giving complete details on Zagar standardized keyway broaches for use on 20- and 36-inch stroke machines, together with data on work-holding adapters. C-21

Portable Electric Tools

PORTABLE ELECTRIC TOOLS, INC., 320 W. 83rd St., Chicago 20, Ill. Catalogue 50A, illustrating and describing the company's line of "Hi-Power" and "Zephyr" portable electric drill and attachments, hand saws, paint sprayers, etc. C-22

Mechanical Counters

STREETER-AMET CO., 4101 Ravenswood Ave., Chicago 13, Ill. Bulletin entitled "Mechanical Recorders for Science and Industry," descriptive of the company's latest recording mechanical counters actuated by electrical impulses. C-23

Cylindrical Grinders

LANDIS TOOL CO., Waynesboro, Pa. Catalogue covering the company's standard and special-purpose cylindrical grinders, which include universal, plain, roll, crankshaft, cam, valve, multiple-wheel, and race grinders. C-24

Marforming

HYDROPRESS, INC., 570 Lexington Ave., New York 22, N. Y. Folder explaining the Marforming of rubber-pressure deep-drawing method of forming sheet-metal parts and its technical and economical advantages. C-25

Reamers for Tough Materials

PRATT & WHITNEY DIVISION NILES-BEMENT-POND CO., West Hartford 1, Conn. Circular 427-4, describing the Pratt & Whitney "Blue Helix" reamers designed particularly to machine tough materials. C-26

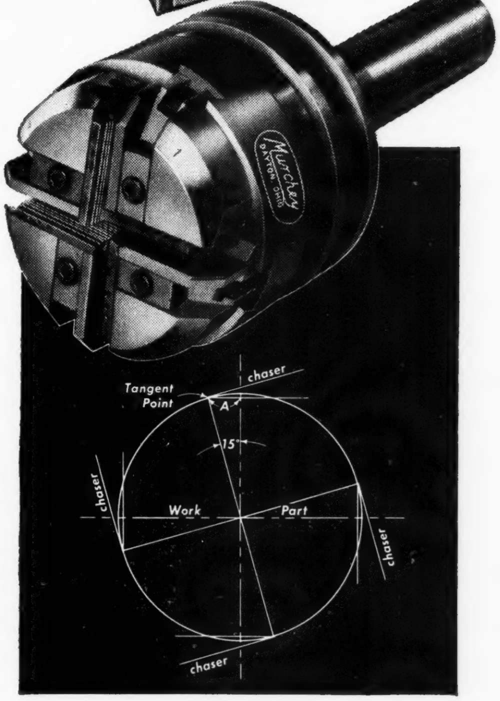
Adjustable Push-Broaches

KASE MACHINE CO., 18429 Buffalo Ave., Cleveland 19, Ohio. Bulletin 13, containing operating and engineering data, specifications and prices covering the Glenny line of adjustable push-broaches for cutting keyways. C-27

To obtain copies of these publications, fill in number at end of note on Inquiry Card, page 215.

NO CHASER-WASTING REGRINDS WITH THIS MURCHEY TEAM

Simply "clean up" your chasers as required, and RESET to cutting position instead of REGRINDING



Write for catalog

This Murchey Micrometer Setting Fixture assures each chaser being set accurately in its holding block, precisely positioned to the ideal cutting point. Then, when the blocks are placed in the Murchey Tangent Die Head, each chaser bears an equal amount of the cutting load. No cutting edge works harder or wears faster than another.

This Fixture will handle both right and left hand holding blocks for all Murchey Tangent Chaser Die Heads.

ADVANTAGES

Murchey threads are accurate and uniform.

More threads can be cut between chaser adjustments.

Wear is equal on all chasers.

Chasers in Murchey Tangent Die Heads outlast others many times.

Ask for the full Murchey "Chaser-Saver" story.

5482

Since 1904

Lower cost per thread . . .

WITH MURCHEY TOOLS

Use Murchey collapsible taps, self-opening die heads (tangent and radial chaser types) and special threading tools

MURCHEY DIVISION OF THE

MURCHEY

SHEFFIELD CORPORATION

DAYTON 1, OHIO, U.S.A.

Disk Grinders

MATTISON MACHINE WORKS, Rockford, Ill. Bulletin descriptive of the Mattison Hanchett Type No. 153 vertical-spindle disk grinder, a rigid machine for grinding flat surfaces where close limits are not required to be maintained. C-28

Pivoted-Blade Shears

CLEVELAND CRANE & ENGINEERING Co., 5420 E. 282nd St., Wickliffe, Ohio. Catalogue 2011-C, describing the features of design of the Steelweld pivoted-blade power shears, designed for heavy-duty production work. C-29

General-Purpose Lathes

HARDINGE BROTHERS, INC., Elmira, N. Y. Bulletin HL, illustrating and describing the new Hardinge 10-inch general-purpose lathe. Complete specifications are included. C-30

Universal Tool-Grinding Machines

NIFE, INC., 165 Broadway, New York 6, N. Y. Catalogue describing Nife universal high-precision tool-grinding machines with new design features. C-31

Power Presses

SALES SERVICE MACHINE TOOL Co., 2351 University Ave., St. Paul 4, Minn. Leaflet descriptive of the No. 85 "Press-Rite" open-back inclinable power presses with built-in tie-rods. C-32

Compressors

INGERSOLL-RAND Co., 11 Broadway, New York 4, N. Y. Circular 3127-A, describing a new line of JVG gas-engine driven compressors, available in three sizes—110, 165, and 220 H.P. C-33

Dial Snap Gages

STANDARD GAGE CO., INC., Poughkeepsie, N. Y. Circular descriptive of a dial gage attachment that can be easily installed on AGD adjustable-limit snap gages. C-34

Visual Contour Grinders

CLEVELAND GRINDING MACHINE Co., 6514 St. Clair Ave., Cleveland 3, Ohio. Bulletin describing three important visual-grind techniques for optical profile grinding, and the equipment employed. C-35

Long-Flute Drills

NATIONAL TWIST DRILL & TOOL Co., Rochester, Mich. Circular supplementing Catalogue 16, containing specifications for National No. 2101 long-flute heavy-duty drills. C-36

Hydraulic Bending Attachment

HOSSFELD MFG. Co., Winona, Minn. Folder descriptive of a new hydraulic attachment for the Hossfeld No. 2 universal pipe, bar, and angle-iron bender. C-37

Flexible-Shaft Units

ELLIOTT MFG. Co., 519 Prospect Ave., Binghamton, N. Y. Circular 199, containing data on heavy-duty flexible shaft units, including information on torque and horsepower. C-38

Recording Thermometers

BRISTOL Co., Waterbury 20, Conn. Bulletin containing 44 pages of data on the Bristol Series 500 liquid-filled, vapor-pressure, and gas-filled thermometers. C-39

Magnetic Controls

FURNAS ELECTRIC Co., 1061 McKee St., Batavia, Ill. Catalogue 50, describing a new magnetic starter for electric motors, made in 5- and 7 1/2-H.P. sizes, with local or remote control. C-40

Injection Molding Equipment

FELLOWS GEAR SHAPER Co., 78 River St., Springfield, Vt. Circular describing the design features and capacity of "Speed-Flo" injection molding machines. C-41

Steel Measuring Tapes

L. S. STARRETT Co., Athol, Mass. Bulletin 112, on Starrett precision steel tapes, levels, transits, and other tools for engineers, draftsmen, surveyors, etc. C-42

Pneumatic Press

CLAYTON MFG. Co., 207 Delaware Ave., Buffalo 2, N. Y. Catalogue illustrating and describing the new Akrite air press recently added to the company's line. C-43

Hard-Facing in the Steel Industry

AIR REDUCTION SALES Co., 60 E. 42nd St., New York 17, N. Y. Circular entitled "Hard-Facing Applications in the Steel Industry." C-44

Portable Electric Tools

DUMORE Co., Racine, Wis. Catalogue on the Dumore line of electric tool-post grinders, quills, flexible-shaft tools, and high-speed drilling equipment. C-45

End-Mills

PUTNAM TOOL Co., 2981 Charlevoix Ave., Detroit 7, Mich. Bulletin listing eleven new stock end-mills available from this company, including prices. C-46

Electrodes

METAL & THERMIT CORPORATION, 100 E. 42nd St., New York 17, N. Y. Catalogue containing data on seven Murex mild-steel arc-welding electrodes. C-47

Nut Retainers

TINNERMAN PRODUCTS, INC., 2036 Fulton Road, Cleveland, Ohio. Booklet listing forty-nine standard sizes of "Speed Grip" nut retainers. C-48

Small-Size Live Center

HERBERT CROSS & SON, 9 Highland Ave., Bala-Cynwyd, Pa. Folder descriptive of the "Wee" extra-capacity needle-bearing live center. C-49

Meehanite Shapes and Forms

MOTORS & METALS, INC., 220 W. 42nd St., New York 18, N. Y. Folder illustrating standard Meehanite shapes and forms available for immediate delivery. C-50

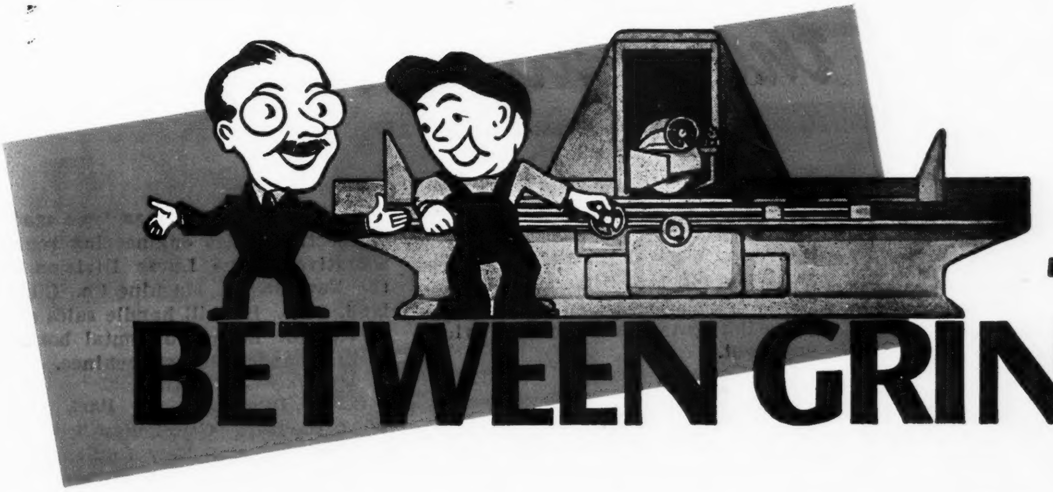
Functional Photography

EASTMAN KODAK Co., 343 State St., Rochester 4, N. Y. Bulletin describing various applications of photography in industry and business. C-51

Hard-Facing Alloys

ALLOY RODS Co., 8705 W. Market St., York, Pa. Bulletin announcing a new line of "Wear-Arc" electrodes for use in hard-facing operations. C-52

To obtain copies of these publications, fill in number at end of note on Inquiry Card, page 215.



BETWEEN GRINDS

By E. S. Salichs

More Holes in Your Card More Holes in Your Wallet?

Possible combinations in ordering an automobile total well over 14,000, as Buick Motor Division, GMC, knows with its 32 different 1950 models, 15 colors, 30 upholstery styles, and 21 accessories. So the company has installed an "electric brain" system (said to be only one of its kind in automotive industry). When ordering a car, your combinations are registered by punched holes on a card. That card then controls every step in the production of the auto and the finished Buick matches your specifications exactly. If you changed your mind midcard, it would be a shock to the electric brain, no doubt.

What a Pair!

At a convention banquet recently attended by a member of our staff, a gentleman seated next to him was reviewing the names of the men at the far end of the table, claiming that he used a memory system of association with things. One chap stumped him, however, until he recalled that the surname had something to do with a peach. Jokingly, our man said, "Bartlett?" "Yes, that's right. Mr. Bartlett."

Young Man with a Handbook Starts Off on Right Foot

Nine MACHINERY'S HANDBOOKS were awarded as scholarship gifts in the local trade schools of Buffalo in June.

Pipeful of Ignorance

In the office of a pipe manufacturer, a framed telegram hanging on the wall serves as an amusing reminder of hectic times to said executive. Seems that during the last war, the concern had a pipe order with certain thread specifications from some department in the Government. On the due-for-delivery date, the department was notified that the pipe was available but being held up because the machinery for cutting the threads had broken down. Whereupon the telegram now on the wall was received: "Send pipe immediately; forward threads when ready."

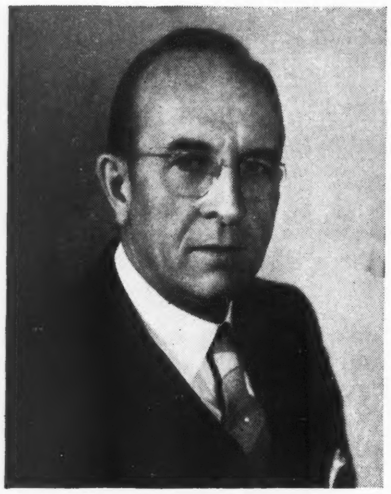
Fish are Dead Ducks

An electronic fish finder, described in *Steel Horizons*, now permits commercial fishermen to "see" schools of fish under water, even in storms and darkness, and can tell the kind of fish spotted, as well as the undercraft conditions. This Bendix Depth Recorder (developed during World War II to locate mine fields and to chart harbors) for which Allegheny Ludlum is supplying special steels and alloys has been installed on boats from Norway to Cuba. Discovering new fish fields is also possible, for the finder has revealed haunts frequented by fish on a vacation from overcrowded piscatorial waters. The only safe place left for a floundering fish is nearby an amateur fisherman's hook.

Newton Gravitates to MACHINERY—Active contributor ROBERT W. NEWTON finished high school in his native Watertown, N. Y., and after some extension work at Syracuse University which included some handy math., started out in the coreroom, foundry and machine shop of the New York Air Brake Co. A year later he enrolled at the Oswego State Teachers College, but then giving up the idea of teaching, returned to Air Brake as an apprentice draftsman in the tool designing department, the wiser, however, for machine shop practice and mechanical drawing courses. Five years later, Mr. Newton became a junior tool designer in the routing department of the Glenn L. Martin Co., but in six months he was back at Air Brake, where he is presently as-

sistant chief tool designer. Recalling the war years at the latter company, Mr. Newton comments that all the resourcefulness and ingenuity of their tool designers were exerted as they coped with new precision assignments such as the manufacture of brake equipment for American and Allied railways, Hycon "Stratopower" pumps, General Sherman tank hulls, etc. Mr. Newton lives near the Thousand Islands and Adirondacks, so his summer hobbies fit the region—bass fishing, camping, swimming. His winter hobbies fit indoor recreation anywhere — bridge, canasta, reading, A.S.T.E. meetings. Year-round contributing to MACHINERY (summer special, page 183) also occupies Mr. Newton. And then a six-year-old son really keeps him busy!

News of the Industry



Charles A. Dostal who has retired as Westinghouse vice-president after forty-three years with the company

California

CHARLES A. DOSTAL, vice-president of the Westinghouse Electric Corporation since 1943, retired recently after completing more than forty-three years of service with the company. He began his career with the Westinghouse organization as an apprentice at East Pittsburgh, Pa., and was rapidly advanced to various positions of responsibility in the selling end of the business. In August, 1939, he was made Pacific Coast district manager with headquarters in San Francisco, Calif. He received the Westinghouse Order of Merit for distinguished service—the highest company award—in 1942, and in July of the following year was elected a vice-president.

Connecticut and Massachusetts

HARTFORD SPECIAL MACHINERY CO., Hartford, Conn., announces the appointment of the following representatives: DAYTON & BAKEWELL, 1939 Santa Fe Ave., Los Angeles, Calif., for swagers, die polishers, and "Super-Spacers"; HOFFMAN & HEARTT, 3005 S. Grand Ave., Los Angeles 7, Calif., for automatic drilling and tapping machines and the Hartford thread roller; THOMAS WALLACE, 806 W. 5th St., Los Angeles, Calif., for the Hartford "Super-Spacer" and sensitive drilling machines; and WILLIAM SCHEER CO., 6376 Clayton Road, St. Louis 17, Mo., for automatic drilling and tapping machines, thread rollers, die polishers, and sensitive drilling machines.

CARL F. SCHNUCK has been appointed director of engineering of the Farrel-Birmingham Co., Inc., Ansonia, Conn., and WARREN C. WHITTUM has been made chief engineer. Mr. Schnuck has recently completed fifty years of service with the company. Mr. Whittum has been connected with the company since 1930.

(Left) Carl F. Schnuck, recently appointed director of engineering of Farrel-Birmingham Co. (Right) Warren C. Whittum, new chief engineer

ALFRED J. LEBRUN has been made Connecticut sales engineering representative of the Lucas Division of the New Britain Machine Co., Cleveland, Ohio. He will handle sales and service for Lucas horizontal boring, drilling, and milling machines.

G. W. BUSH CO., 601 Park Ave., West Hartford, Conn., has been appointed exclusive New England distributor for the line of precision gears and flexible gear couplings made by the Sier-Bath Gear & Pump Co., Inc., North Bergen, N. J.

A. E. CAMPBELL has been made sales manager of the Clapp Instrument Co., Webster, Mass., manufacturer of the "Acragage."

Illinois and Indiana

GEORGE O. HENDEE, sales and service engineer in the Philadelphia area for the Hannifin Corporation, Chicago, Ill., has been transferred to the New England territory to take the place of ELLIOTT D. THOMPSON, sales representative at Boston, who has resigned after more than twenty years of service with the firm. Mr. Hendee will make his headquarters at Rochester, Mass. He is succeeded at Philadelphia by JOSEPH O'MALLEY.

FRED M. GILLIES has been elected executive vice-president of the Acme Steel Co., Chicago, Ill., to take the place made vacant when CHESTER M. MACCHESNEY was elected chairman of the board last fall.

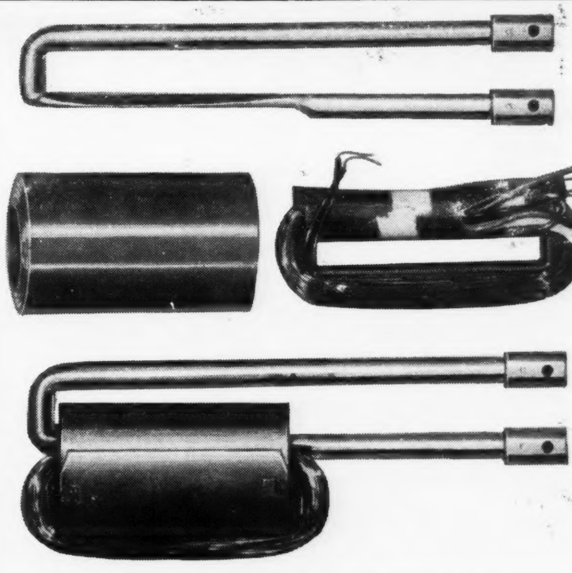
AUSTIN E. COLE has been elected treasurer of the Illinois Tool Works, Chicago, Ill. Mr. Cole has been associated with the company since 1936.

EDWARD F. SCHALK has been made sales manager of the Stainless Steel Division of A. M. Castle & Co., 1132 W. Blackhawk, Chicago, Ill.

KENNETH L. CLARK has been appointed general sales manager of the Kropp Forge Co., Chicago, Ill.

JOSEPH T. RYERSON & SON, INC., Chicago, Ill., announces the following changes in executive personnel: HAROLD B. RESSLER, previously vice-president and general manager of sales, has been elected first vice-president; C. L. HARDY, former assistant vice-president, has been made assistant to the president; and THOMAS Z. HAYWARD, assistant general man-

HEAVY, LESS EFFICIENT and slower to assemble, was the original Weller Soldering Gun composed of the parts shown. Compare these with the fewer parts at right in the new Gun, and you'll readily see why the new streamlined Weller is so popular.



THE NEW WELLER SOLDERING GUN handles 250 watts; heats, ready for use, in five seconds; has longer range to get into the tight spots, and is equipped with spot light. Uses current only when trigger is operated. It is assembled faster. Requires no bolts or nuts. The ⅜" Revere Copper Rod that replaces the secondary coil in the transformer is sheared, flattened, and bent at right angles in a 200-ton press in a single operation.

COPPER TREATS YOUR PRODUCT BETTER WHEN YOU

Control Your Temper

Revere Copper Rod replaces Secondary Coil in Soldering Gun Transformer . . . reduces number of parts, makes for a speedier, more efficient assembly . . . also makes possible a lighter, more compact unit of increased capacity.

When the Weller Manufacturing Company, Easton, Pa., was completing the development of its new electric soldering gun, they were confronted with this problem: The ⅜" Revere Copper Rod used to replace the secondary coil in the transformer had to maintain its rigidity yet be sufficiently soft so that during the shearing, coining, and bending operations there would be no breaking or splitting of the rod.

Revere's Technical Advisory Service recommended a certain temper copper rod. It was discovered that Weller was getting a twist in the rod when it was installed in the assembled gun. Other tempers were tried and tested. Then a copper rod of a slightly harder temper than the first was recommended. That was it! Proper temper was the key. Proper temper was also the key to the .291 dia. copper rod used for the Soldering tip itself. For this, too, had to retain its rigidity and yet remain soft enough to be coined, punched, and formed without fracture.

"In addition to being extremely helpful in arriving at the proper tempers, Revere also recommended that we specify our rod in multiple lengths, and thus save considerably on scrap. They were also helpful in solving the problem of attaching the brass sleeve to the secondary rod in our Soldering Gun," the Weller Manufacturing Company tells us.

So you see, Revere's interest in your problem does not stop with the recommendation of its products. Perhaps Revere can help you. Why not take your current problem to the nearest Revere Sales Office and see?

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801
230 Park Avenue, New York 17, New York

• • •

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.
Sales Offices in Principal Cities, Distributors Everywhere.

For more information on products advertised, use Inquiry Card, Page 215

(Left to Right) Harold B. Ressler, newly elected first vice-president of Joseph T. Ryerson & Son, Inc.; C. L. Hardy, assistant to the president; and Thomas Z. Hayward, general manager of sales

ager of sales, becomes general manager of sales for the thirteen Ryerson steel service plants. ROLAND W. BURT has been appointed sales manager of the Chicago plant, succeeding Mr. Hayward.

V. H. DIETERICH, vice-president and director of Joseph T. Ryerson & Son, Inc., Chicago, Ill., has retired after more than forty-five years of service with the company. He resigned in 1949 for reasons of health, and during the last year has acted in a consulting and advisory capacity. Mr. Dieterich headed the structural, fabricating, and work order divisions of the Ryerson business for many years. In 1934, he became assistant vice-president, and was elected vice-president in 1937.

MICHIANA PRODUCTS CORPORATION, Michigan City, Ind., maker of alloy castings and high-temperature fans, announces the following additions to its sales force: H. B. SCOTT is in charge of the southern Indiana area, with headquarters at 310 Test Bldg., Monument Circle, Indianapolis. Ind.; L. S. JOHNSON has been assigned to the Philadelphia area, with headquarters at 637 W. Sedgwick St.; and A. J. POPOVICH has been placed in charge of the northern Indiana territory and is located at the company's headquarters in Michigan City.

Michigan

HAPMAN CONVEYORS, INC., Detroit, Mich., and the C. H. DUTTON CO., Kalamazoo, Mich., have merged and will be known in the future as the HAPMAN-DUTTON CO. The company will be composed of two divisions—the Hapman Conveyors Division located at 19209 W. Davison Ave., Detroit 23, with PETER P. RUPPE, assistant vice-president, in charge; and the Dutton Boiler Division, 630 Gibson St., Kalamazoo 6, with J. DAVID, assistant vice-president, in charge. Officers of the new company are president and general manager, H. W. HAPMAN; and vice-president and assistant general manager, ROBERT J. BROWN.

FRANK W. KABAT has been made head of the field representatives department of the Physicists Research Co., Ann Arbor, Mich., manufacturer of Profilometers and other surface-measurement instruments. The company also announces the appointment of ARNOLD W. LLOYD and GEORGE HABER, JR., as field representatives.

GARNER-SHELTON CO., 20050 Livernois Ave., Detroit 21, Mich., has been appointed distributor in the Detroit area for the BUTTERFIELD DIVISION OF THE UNION TWIST DRILL CO., Derby Line, Vt., manufacturer of taps, dies, reamers, and special metal-cutting tools.

HENDEY MACHINE CO., Torrington, Conn., announces that it has discontinued its sales office at 1534 Dime Bldg., Detroit, Mich., and is now represented by ASSOCIATED MACHINERY SALES, located at 147 Jos. Campau, Detroit.

R. L. PEASLEE has joined the Wall Colmonoy Corporation, Detroit, Mich., in the capacity of development engineer. For the last nine years he has been employed at the Wright Aeronautical Corporation.

MELVIN L. BUNTING has joined the Acheson Colloids Corporation, Port Huron, Mich., in the capacity of technical service engineer.

Minnesota and Missouri

R. H. OLSON, formerly vice-president in charge of sales of the Electric Machinery Mfg. Co., Minneapolis, Minn., was recently elected president of the company, succeeding W. H. FELDMANN, who has joined the Worthington Pump & Machinery Corporation as vice-president in charge of sales. A. P. BURRIS has been elected vice-president in charge of sales to take Mr. Olson's place, and P. L. SHAWLEY has been made New York district sales manager, replacing Mr. Burris.

FERRACUTE MACHINE CO., Bridgeton. N. J., announces the appointment of KURT P. WESSELING, of the K. P. Wesseling Co., 1221 Locust St., St. Louis 3, Mo., as agent for the complete line of Ferracute power presses in the St. Louis territory.

New York and New Jersey

GENERAL ELECTRIC CO., Schenectady, N. Y., announces the following appointments in the apparatus department: F. L. HEADLEY has been made assistant manager of the Pittsburgh sales office; N. L. WHITECOTTON, manager of the Philadelphia sales office, succeeding Mr. Headley; F. I. KITTREDGE, manager of the Philadelphia apparatus sales office's Industrial Customer Division; and W. C. MASON, Atlantic District manager of the Agency and Resale Division, with headquarters at Philadelphia. In the Turbine Division of the apparatus department, J. P. KELLER, formerly superintendent of generator and turbine bucket manufacturing, has been appointed assistant to the manager of the Industrial Divisions, and will be succeeded by L. E. NEWMAN,

previously assistant manager of the Turbine and Gear Sales Division at Lynn, Mass.

CARL DE BOURBON, of Carbet, Inc., 111 Broadway, New York City, has been appointed representative in the New York territory of the Federal Machine & Welder Co., Warren, Ohio, manufacturer of resistance welders and Warco mechanical presses. The company was formerly represented by A. A. PROBECK Co., 50 Church St., New York.

GEORGE T. FRASER has been appointed assistant manager of tool steel sales for the Crucible Steel Co. of America, New York 17, N. Y. His headquarters will be at Syracuse, N. Y. He was formerly manager of Rexalloy sales at Harrison, N. J.

ADAMANT TOOL Co., Bloomfield, N. J., eastern subsidiary of the Wheel Trueing Tool Co., Detroit, Mich., will be known in the future as the WHEEL TRUEING TOOL CO. OF NEW JERSEY. Coincidental with the change of name, it is announced that IRVING RIVKIN has joined the company as assistant to Ed. W. Weimar, Jr., vice-president. Mr. Rivkin will make his headquarters at Bloomfield.

JACK ETTINGER has been appointed representative in the New York metropolitan area for the Bennett Machinery Co., 30 Church St., New York City. His headquarters will be at the Bennett plant in Clifton, N. J.

Ohio

AMERICAN STEEL & WIRE Co., Rockefeller Bldg., Cleveland 13, Ohio, announces the following appointments: CHARLES J. PETRY, assistant division superintendent of steel works at the company's South Works in Worcester, Mass.; JOSEPH A. WALSH, supervisor of engineering and maintenance at the New Haven, Conn., Works; and WILLIAM H. LYON, supervisor of engineering and maintenance at the Trenton, N. J., Works.

JAMES F. LINCOLN, president of the Lincoln Electric Co., Cleveland, Ohio, was the recipient of an honorary degree of Doctor of Science from the Ohio State University, conferred on June 9 at the commencement exercises. Mr. Lincoln, a recognized industrial leader, received the degree of electrical engineering from the university in 1926, and is a former member of the board of trustees.

JOHN C. COTNER has been appointed president of the Hydraulic Press Mfg. Co., Mount Gilead, Ohio, manufacturer of metal-working presses, plastic molding machines and metal die-casting machines. Mr. Cotner has long been active in the hydraulic machinery field. For twenty years he was associated with the Logansport Machine Co., Inc., of Logansport, Ind., serving as vice-president and general manager and later as president. During 1945 and 1946, Mr. Cotner was vice-president of Gerotor May, Inc., Baltimore, Md., manufacturer of hydraulic components, and in 1949, he was president of Consolidated Industries, Lafayette, Ind.

John C. Cotner, recently appointed president of the Hydraulic Press Mfg. Co.

R. S. KORONCAI has been appointed sales manager of the Cleveland Industrial Tool Corporation, Cleveland, Ohio, succeeding HUNTER N. WILLIAMS, who has become vice-president in charge of sales. Prior to joining the company, Mr. Koroncai was director of sales for the Hydraulic Equipment Co., of Cleveland.

WALTER R. CATEY has been named sales engineer for Continental Tooling Service, Inc., Dayton, Ohio. Prior to this connection, he was with the City Engineering Co. in Dayton. GEORGE D. LUDINGTON has been made sales and project engineer for the company.

FRED C. AHRENDT Co., 3636 Detroit Ave., Toledo 12, Ohio, has been appointed representative of the LOVEJOY TOOL CO., INC., Springfield, Vt., manufacturer of milling cutters, boring heads, arbors, counterbores, end-mills, flywheels, etc.

PERRY T. COONS, who has been connected with the sales service department of the American Steel & Wire Co., Cleveland, Ohio, for forty years, has just been appointed assistant to the vice-president.

T. S. RODERICK has been named general manager of Non-Ferrous Permanent Mold, Inc., Mansfield, Ohio.

Pennsylvania

DR. KENT R. VAN HORN will become associate director of research for the Aluminum Co. of America, Pittsburgh, Pa., on August 1. Dr. Van Horn is now assistant director of research, and has been in charge of the company's branch laboratories at Cleveland, Ohio, since 1945. In his new position, he will be located at the headquarters of the research organization at New Kensington, Pa.

BROOK A. GETZ has been named Pittsburgh sales representative for the Simmons Machine Tool Corporation, Albany, N. Y., rebuilder and manufacturer of machine tools. Mr. Getz was associated with the Sidney Machine Tool Co., Sidney, Ohio, for a number of years prior to joining the Simmons organization in 1937. His headquarters will be 3541 Laketon Road, Pittsburgh 21, Pa.

KENNAMETAL, INC., Latrobe, Pa., manufacturer of cemented-carbide tools, announces the appointment of THOMAS J. KNIFF, JR., as representative in the New York office, 11 W. 42nd St., and FRED MOORE as representative in the central district, with headquarters at 5531 Woodward Ave., Detroit, Mich.

E. A. CARPENTER has been appointed Chicago district sales manager of the Firth Sterling Steel & Carbide Corporation, McKeesport, Pa., and C. E. HUGHES has been made district sales manager of the corporation's newly created southern district, with headquarters at Birmingham. Ala.

JOSEPH A. BLIZMAN has been made sales and service engineer for the Herman Pneumatic Machine Co., Union Bank Bldg., Pittsburgh, Pa. He will be located at 349 South St., Evans City, Pa.

ELMER F. TWYMAN has been elected vice-president in charge of the Philadelphia Division of the Yale & Towne Mfg. Co., to succeed JAMES C. MORGAN, who has retired.

DEVILBISS Co., Toledo, Ohio, manufacturer of air-compressor and spray-painting equipment, is erecting a new plant in Somerset, Pa.

* * *

The George Gorton "Big Brother" Scholarship in Mechanical Engineering for the year 1950 was awarded to William L. Walters, a senior in the Lutheran High School of Racine, Wis. The scholarship provides $125 a semester toward the student's expenses in completing a four-year course in mechanical engineering. It also offers an opportunity for the student to work during the summer for the George Gorton Machine Co. to gain practical experience.

Obituaries

Gen. Thomas S. Hammond

General Thomas Stevens Hammond, chairman of the board of the Whiting Corporation, Harvey, Ill., died at his home in Chicago, Ill., on June 15. General Hammond was well known in the business world. Entering the employ of the Whiting Corporation in 1907 as assistant purchasing agent, he rose to the positions of president and general manager and for several years had been chairman of the board.

General Hammond was born at Crown Point, N. Y., on October 29, 1883, and received his education in the public schools of Chicago and the University of Michigan. He was a director in many business and civic enterprises, and held life membership in the American Foundrymen's Society and the American Ordnance Association.

He had a noteworthy military career, beginning as a private in the National Guard in 1915 and serving in both world wars. He was retired as major general of the Illinois National Guard in May, 1940. In January, 1942, he entered the services of the Chicago Ordnance District, War Department, serving successively as production advisor, chief of production, deputy district chief, and district chief. General Hammond is survived by his wife and two sons.

H. O. K. Meister

H. O. K. Meister, general manager of the Hyatt Bearings Division, General Motors Corporation, Harrison, N. J., died on June 10 at his home on Shelter Island, N. Y., at the age of sixty-two years. Mr. Meister had been general manager of the Hyatt plant since 1937. He was born in Milwaukee, and joined the Hyatt organization in 1914, having previously been connected with the shop and engineering department of the Allis Chalmers Corporation, where he started as an apprentice.

He was first connected with the Hyatt Chicago office, and later became assistant advertising manager at Harrison. Subsequently he served as assistant sales manager of the Tractor and Implement Division, becoming general sales manager in 1920 and assistant general manager in 1929. In 1937, he was made general manager, a position that he held until his death. Mr. Meister was active in many civic and business associations.

Alfred W. Gregg, consulting engineer for the Whiting Corporation, Harvey, Ill., died on June 8 at the Columbia Hospital in Milwaukee, Wis., after a short illness, at the age of sixty-six years. Mr. Gregg had served for the last fourteen years as consulting engineer for the Whiting foundry equipment department. Prior to that he was connected in an executive capacity with various foundry organizations. He was very active in the American Foundrymen's Society, and in 1944 was awarded the J. H. Whiting Gold Medal of the A.F.S. in recognition of his outstanding contributions to the foundry industry and the Association, especially for his work in the development of steel melting practices.

George W. Pressell, vice-president of E. F. Houghton & Co., Philadelphia, Pa., manufacturer of industrial oils, leathers, and metal and textile processing products, died suddenly on June 5 at his summer home in Ocean City, N. J. He was sixty-two years old.

Mr. Pressell started as a messenger boy with the company forty-seven years ago. He had held the offices of chief chemist, secretary, second vice-president, general sales manager, and director of sales. Since 1919 he had been a member of the board of directors. He was also president of E. F. Houghton & Co. of Canada, Ltd.

Howard M. Smith, metallurgist at the Ambridge, Pa., plant of the Wyckoff Steel Co. for the last twenty-six years, died on June 2 as the result of an automobile crash. Mr. Smith was fifty-four years of age, and was well known in steel metallurgical circles. He was a member of the American Iron and Steel Institute, the American Society of Metals, and the Society of Automotive Engineers.

Walter C. Wassman and his son, Walter G. Wassman, were drowned recently when the boat that they were in capsized in the Des Plaines river near Des Plaines, Ill. The elder Mr. Wassman was manager of the George L. Detterbeck Co., a tool designing concern of Des Plaines, and his son was vice-president of the company.

* * *

Elmes Molding Press (Correction)

In June Machinery, pages 210 and 211, the capacity figures for the Elmes molding press manufactured by the Elmes Engineering Division of American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio, were stated incorrectly. The sentence should have read: "There is a choice of five cylinder capacities—0.6 ton, 1.2 tons, and 2.4 tons for air application, and 3 tons and 6 tons for hydraulic service."

Change in Steel Reduces Costs of Cutter Plate

The cutter-holding plate for a candy wrapping machine used by the Ideal Wrapping Machine Co., Middletown, N. Y., was originally machined from 18-8 chrome-nickel stainless steel, since it was required to have high strength and sufficient corrosion resistance to withstand the attack of sugar and fruit acids. At the same time, it was necessary to have the slots in the periphery of the plate fit the knives so accurately that there would be no play.

In making a study of this application, it was found that the 18-8 steel had a higher resistance to corrosion than was actually needed and that Carpenter No. 5 (Type 416) steel—a straight-chrome free-machining grade—provided the necessary strength and corrosion resistance at less cost. In addition, the latter steel also had the advantage of good machinability to uniform tolerances, and required no final heat-treatment. The actual reduction in the cost of the unit resulting from the change in material was $6.

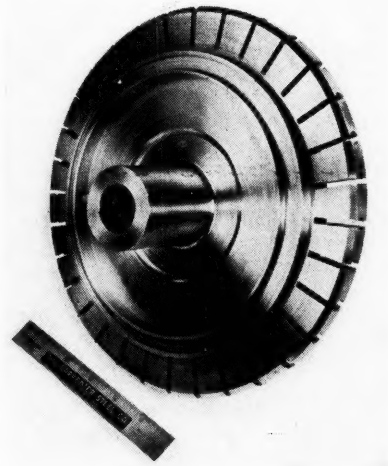


Plate for holding candy-cutting knives which offered problem in material selection

* * *

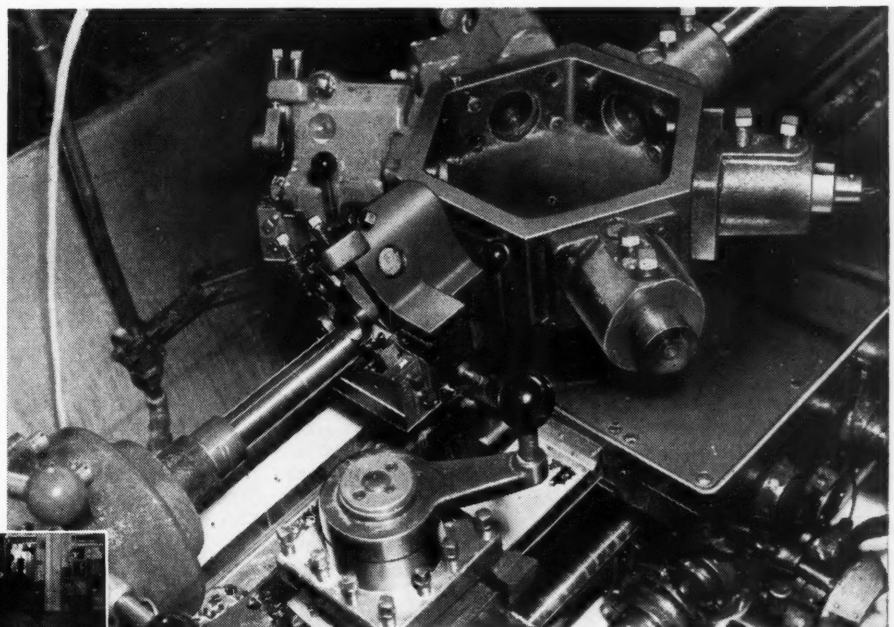
American Society for Metals Selects New Officers

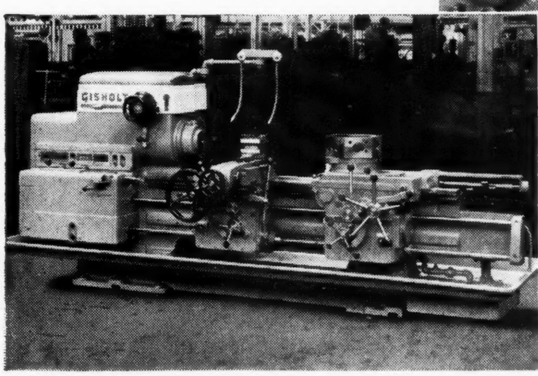
The following officers have been nominated to serve for the year 1950-51 by the American Society for Metals: President, Walter E. Jominy, staff engineer, Chrysler Corporation; vice-president, Dr. John Chipman, head of the Department of Metallurgy, Massachusetts Institute of Technology; secretary, W. H. Eisenman (renominated); treasurer, Ralph L. Wilson, chief metallurgist, Timken Steel & Tube Co.

take shaft jobs Like This:

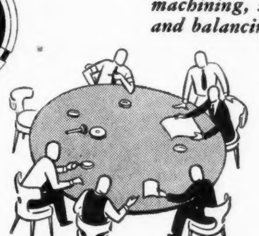
they take less time on
GISHOLT TURRET LATHES

Yes, even in lots as small as 5 or 10 parts, you can't beat turret lathes on this kind of work. Parts are machined complete in 2 operations—total time is less than 4 min.





THE GISHOLT ROUND TABLE *represents the collective experience of specialists in the machining, surface-finishing and balancing of round and partly round parts. Your problems are welcomed here.*



no extra equipment needed!

With no more than your standard bar equipment, you're all set to cut machining costs on shafts like these. No previous operations . . . such as cutting to length or centering . . . are necessary. And with *two or more tools* from turret and side carriage, you have the basic advantage of turret lathe economy—the time saving that means lower costs.

Before you turn to extra equipment or special attachments, look into the possibilities of doing the job the quick and easy way on Gisholt Turret Lathes. Gisholt engineers will gladly help you.

GISHOLT MACHINE COMPANY
MADISON 10, WISCONSIN

TURRET LATHES • AUTOMATIC LATHES • SUPERFINISHERS • BALANCERS • SPECIAL MACHINES

For more information on products advertised, use Inquiry Card, Page 215

New Books and Publications

INDUSTRIAL MATERIALS-HANDLING. By Irving M. Footlik, Charles F. Yarham, and J. Francis Carle. Published by the Lincoln Extension Institute, Inc., 1401 W. 75th St., Cleveland 2, Ohio. Price, $4.75.

The first comprehensive treatment of the subject of materials-handling, embracing the basic principles, practices, equipment, and applications, is presented in this new book. Previously, complete information on the subject has been obtainable only by reference to widely scattered sources. An idea of the scope of the book will be obtained from the following list of chapter headings: Development and Scope of Materials-Handling; Fundamentals of Materials-Handling Operations; Selection of Materials-Handling Equipment; Handling Equipment — Floor-Operated; Handling Equipment—Miscellaneous; Conveyors; Overhead Handling Equipment; Power Industrial Trucks; The Fork Truck; Pallets and the Pallet System; Unit Loads; Plant Lay-Out; How to Make a Materials-Handling Analysis; A Typical Industrial Solution; and Materials-Handling Organization.

The book has been written to meet the demand for information on the subject from industry, colleges, technical institutes, and professional societies. Its objective is to show how to effect savings of money, time, and effort in industrial handling processes by the application of new analyses, equipment, and procedures.

STANDARDS FOR BALL AND ROLLER BEARINGS AND STEEL BALLS. Set of standards published in a buckram binder by the Anti-Friction Bearing Manufacturers Association, Inc., 60 E. 42nd St., New York 17, N. Y. Price, $5.

These standards, which were prepared by engineering committees of the Association, include all standards that have been approved up to the present time. They are divided into ten sections for convenient reference, covering Terminology; Boundary Dimensions; Snap Ring Dimensions; Tolerances; Gaging Practices; Bearing Identification Code; Packaging; Bearing Mounting; Mounting Accessories, such as Lock-Nuts, Lock-Washers, and Tapered Adapter Sleeves; Method for Evaluating Load Ratings for Ball Bearings; and Steel Balls.

As regards terminology, it is stated that this is the first time in the bearing industry that a standard terminology has been accepted by manufacturers. The section giving the latest standard terminology is illustrated by many cross-section drawings on which all the parts are identified. The bearing identification code is a common parts number system for use by bearing manufacturers and bearing users, adopted to avoid the confusion arising from each manufacturer using his own designations.

WELDING HANDBOOK. 1650 pages, 6 by 9 inches. Published by the American Welding Society, 33 W. 39th St., New York 18, N. Y. Price, $12 in the U. S. and Canada; $13 elsewhere.

The third edition of this welding handbook covers the entire subject of welding and cutting in sixty-five chapters. It treats of the more than thirty welding and cutting processes in use by industry today, as well as the welding of ferrous and non-ferrous metals and the application of welding in different industries. There are chapters on cost estimating, welding metallurgy, the physics of welding, filler metal specifications, inspection, and many other subjects. A dictionary of welding terms and general engineering tables are included. At the end of each chapter is given a bibliography listing the important codes, standards, books, and technical articles on the subject covered in that particular chapter. An index covering 69 pages, with complete cross-references, makes it easy to find any particular subject. Items in the index are grouped by welding processes, metals, and applications, as well as under such engineering headings as design, workmanship, inspection, etc.

MACHINE TOOLS FOR ENGINEERS. By Charles R. Hine. 355 pages, 6 by 9 inches. Published by the McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y. Price, $3.50.

The aim of this book is to introduce to the student the fundamentals of machine tools and production processes as an engineering background rather than to provide a text for the shop man. The present volume is the first of two which are based on a course developed at Rensselaer Polytechnic Institute, where the author is assistant professor of manufacturing processes.

This book gives a descriptive, analytical treatment of all types of machine tools—how they are used, what they can do, and what their limitations are. Some of the ways in which machine tools affect the design of any product are also discussed, and the important machining processes are covered. In addition to the standard types of machine tools, the book covers cutting tools, measurement, abrasives and grinding, and such modern processes as micro-finishing. The second volume will deal with casting and forming.

ENGINEERING METALLURGY. By Alexander P. Gwiazdowski. 247 pages, 6 by 9 inches. Published by the C. C. Nelson Publishing Co., Appleton, Wis. Price, $4.

As explained in the preface to this book, the purpose of engineering metallurgy is to help the designer select materials and thermal treatments intelligently, so that the product will be of high quality and the material not too expensive. Accordingly, the book aims to give the student, purchasing agent, production executive, and engineer basic metallurgical information about the nature and characteristics of the commercially important metallic elements and their alloys.

It covers the chemical analysis, properties, applications, and heat-treatments of various steels. Among the materials included are ingot steels, wrought irons, high-speed and commercial tool steels, corrosion- and heat-resisting steels, cast steels, non-ferrous alloys, and bearing metals. For the benefit of the purchasing agent, information is included on specifications for engineering purchases.

STANDARD MANAGEMENT PRACTICE SERIES. Edited by Carl Heyel. Twelve volumes consisting of four groups of three books each. First group available now. Published by the National Foremen's Institute, New London, Conn. Price per volume, $2.50.

The three books in the first group of this series, just brought out, deal with "The Foreman's Place in Management"; "The Foreman's Manpower Job"; and "The Foreman's Production Job." Although covering a common theme, each book in the series is complete in itself and can be obtained separately. The general scheme is to discuss some phase of human relations or leadership in the first book of each group; an aspect of manpower utilization in the second; and some technical operating problem in the third. With three exceptions, the books are written in two sections, each by a different author.

PUNCHES AND DIES. By Frank A. Stanley. 583 pages, 6 by 9 inches. Published by the McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y. Price, $4.75.

All phases of modern punch and die work are covered in this work, which is now in its fourth edition. The practical fundamentals are explained, and the lay-out, construction, and various uses of punches and dies for specific types of work are illustrated. The text is divided into

eight sections, treating of the following subjects: Blanking and Piercing Dies and Other Tools; Compound Dies and Other Cutting Dies; Dies for Shaving and Trimming; Drawing Processes and Tools; Bending and Forming Tools and Operations; Horn Dies, Embossing and Indexing Dies, and Mechanisms; Presses and Dies for Large Parts; and Tool Standards, Lay-out, and Construction Methods.

BEST'S SAFETY DIRECTORY (1950-1951). 511 pages, 8 1/4 by 11 inches. Published by the Alfred M. Best Co., 75 Fulton St., New York 7, N. Y. Price, $5.

This directory covers the entire field of safety, fire protection and control, hygiene, first-aid, and sanitation. It combines the features of a safety manual, directory, index, encyclopedia, and catalogue in one volume. A classified list of safety products or devices to use for specific hazards is given, together with information on how to use them, and the names and addresses of the manufacturers. The hundreds of products included are grouped into sections according to their basic safety use, and a complete cross-index makes it easy to find the particular type of safety device required.

SYMPOSIUM ON DEFORMATION OF METALS AS RELATED TO FORMING AND SERVICE. 126 pages, 6 by 9 inches. Published by the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. Price, $2.

Recent developments that have taken place in dealing with fundamental studies of the plastic deformation and flow of metals are described in this book, which comprises a symposium including five technical papers covering tests of ductility in ship structure; notch sensitivity of ship plate; measurement of ductility in sheet metals; hydraulic bulge testing of sheet metals; and notched bar tension tests on annealed carbon-steel specimens of various sizes and contours.

MANUAL OF OPEN-DIE FORGINGS. 181 pages, 6 by 9 inches. Published by the Open Die Forging Industry, 366 Madison Ave., New York 17, N. Y. Price, $3.

The purpose of this manual is to describe the manufacturing methods, heat-treatment procedures, specifications, and testing or inspection practice used in the production of open-die ferrous forgings, and to clarify the existing terminology. The text is the result of three years of preparation by a committee made up of members of the open-die forging industry.

NICKEL AND ITS ALLOYS. 72 pages. Published by the U. S. Department of Commerce, Washington, D. C., as Circular 485 of the National Bureau of Standards. Obtainable from the U. S. Government Printing Office, Washington 25, D. C., at 50 cents a copy.

Coming Events

SEPTEMBER 13-18 — Twenty-seventh annual convention of the NATIONAL ASSOCIATION OF FOREMEN at the Hotel Statler in Buffalo, N. Y. Further information can be obtained by addressing the Association at its headquarters, 321 W. First St., Dayton 2, Ohio.

SEPTEMBER 18-22—FIFTH NATIONAL INSTRUMENT EXHIBIT of the INSTRUMENT SOCIETY OF AMERICA in the Memorial Auditorium, Buffalo, N. Y. Further information can be obtained from the Society at 921 Ridge Ave., Pittsburgh 12, Pa.

SEPTEMBER 26-29—IRON AND STEEL EXPOSITION, in conjunction with the annual convention of the ASSOCIATION OF IRON AND STEEL ENGINEERS, at the Cleveland Public Auditorium, Cleveland, Ohio. For further information, address the Association, 1010 Empire Bldg., Pittsburgh 22, Pa.

OCTOBER 18-20 — Annual national conference of the SOCIETY OF THE PLASTICS INDUSTRY, at New Ocean House, Swampscott, Mass. Further information can be obtained from William T. Cruse, executive vice-president, 295 Madison Ave., New York 17, N. Y.

OCTOBER 23-27—Fall meeting of the Metals Branch of the AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS in Chicago, Ill. National secretary, E. H. Robie, 29 W. 39th St., New York 18, N. Y.

OCTOBER 23-27—Annual meeting of the AMERICAN SOCIETY FOR METALS in Chicago, Ill. National secretary, W. H. Eisenman, 7301 Euclid Ave., Cleveland 3, Ohio.

OCTOBER 23-27—Annual meeting of the AMERICAN WELDING SOCIETY in Chicago, Ill. National secretary, J. G. Magrath, 33 W. 39th St., New York 18, N. Y.

OCTOBER 23-27—Annual meeting of the SOCIETY FOR NON-DESTRUCTIVE TESTING in Chicago, Ill. National secretary, Philip D. Johnson, Skokie, Ill.

OCTOBER 23-27 — NATIONAL METAL CONGRESS and EXPOSITION at the International Amphitheater, Chicago, Ill. For further information, address W. H. Eisenman, managing director, American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio.

NOVEMBER 27 - DECEMBER 2 — NINETEENTH NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING at the Grand Central Palace, New York 17, N. Y., in conjunction with the annual meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary of A.S.M.E., Clarence E. Davies, 29 W. 39th St., New York 18, N. Y.

Farrel-Birmingham Co., Inc., Ansonia, Conn., recently presented fifty-year service awards to five of its employes at one time—an event unique in its history. In the picture (left to right) are Henry T. King, Roderick R. Hazard, Christopher C. Harris, Joseph B. Wolfe, and Carl F. Schnuck. Mr. Schnuck is receiving a diamond-studded pin from Franklin Farrel, Jr., former chairman of the board of directors, and grandson of Almon Farrel, founder of the company.

Preventing END BEARING OF GEAR TEETH...

- increases their factor of safety
- reduces gear noise
- and prolongs service life

Conventional gear teeth (spur or helical) can be expected to behave as they should theoretically only on the drafting board. When they are made of steel and assembled in a power unit, it is a rare accident when bearing is uniform across the entire faces of any two mating teeth. In nearly every case bearing is concentrated at one end of the tooth or the other where it is most vulnerable to failure.

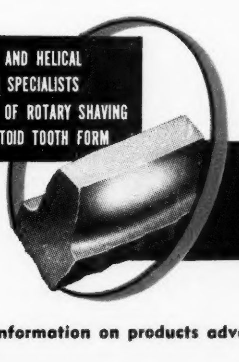
The remedy is the Elliptoid Tooth Form, engineered and produced by Red Ring engineers 12 years ago. The Elliptoid Tooth Form positively prevents end bearing as demonstrated by actual experience in hundreds of applications.

One nationally known manufacturer of trucks and tractors received frequent complaints of gear tooth failures until he adopted the Elliptoid Tooth Form. Since then such complaints have practically vanished. Elliptoid transmission gears tested by this manufacturer for 125 hours under a load of 140 foot pounds and then for an additional 125 hours at 180 foot pounds showed no harmful effects.

Another top ranking tractor manufacturer says the service life of his Elliptoid gears is 30 times greater than that of previous conventional gears. Elliptoid gears are produced on Red Ring Gear Shaving Machines.

Send for descriptive literature.

SPUR AND HELICAL
GEAR SPECIALISTS
ORIGINATORS OF ROTARY SHAVING
AND ELLIPTOID TOOTH FORM



NATIONAL BROACH AND MACHINE CO.

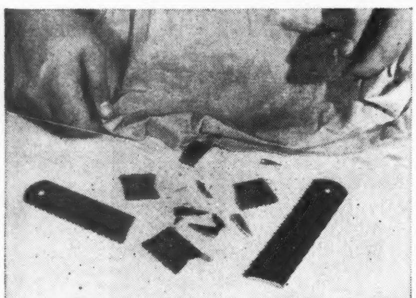
5600 ST. JEAN • • • • • • • • DETROIT 13, MICHIGAN

WORLD'S LARGEST PRODUCER OF GEAR SHAVING EQUIPMENT

Composite Hack Saw Blade Has Many Advantages
for both Production and Occasional Sawing

Metal Sawing was tedious and inefficient at the turn of the century. While power hack saws were in use, they merely eliminated the drudgery of hand sawing, for they could not bring to the operation the cost saving factors of multiplied cutting force and high cutting speeds. This was because the hack saw blades of that day quickly annealled and lost their cutting edge under temperatures generated by metal sawing at any speed much above that of hand sawing or with feed pressures beyond the light feeds used to "scratch" away metal.

With the development of High Speed Steel half of the problem was solved. Here was the ideal cutting agent that readily cut every machinable metal, that did not soften and would withstand the temperatures developed. Further, this new steel held its edge many times as long as any previous blade steel. However, being extremely hard, this steel was inherently brittle.

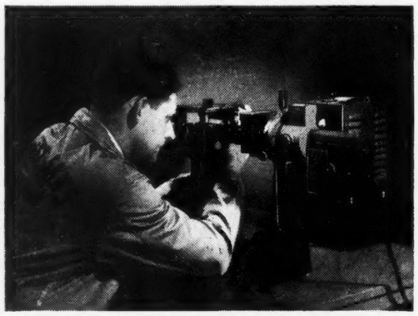


"extremely hard ** inherently brittle"

Though it offered ideal cutting characteristics, it also literally exploded (shattered like plate glass) under even a normal cutting load, as blades were but thin strips of this metal.

Even today, after a quarter century of additional metalurgical research, with closely controlled heat treating processes, few solid high speed steel blades last to deliver more than a percentage of their theoretical cutting life before shattering, and then only when "babied".

As the leading manufacturer of power hack sawing machines, MARVEL assigned its engineers the task of developing a hack saw blade that would stand up under cutting speeds, feeds and working temperatures comparable with those attained on other types of machine tools. All available steels were tested for cutting quality, load carrying ability, and resistance to shock. While alloys of great tensile strength and toughness were found, they were invariably poor in cutting quality in almost directly proportional ratio to their ability

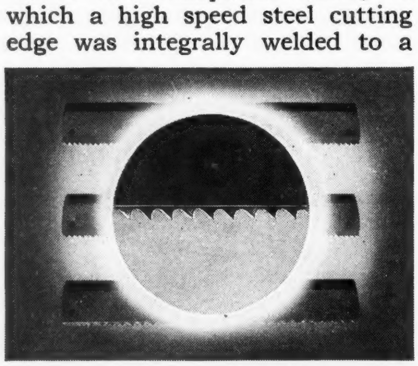


"years of research, tests and refinement"

to withstand load and shock. The characteristics needed were diametrically opposite. It was like seeking a steel that could be both white hot and ice cold at the same instant.

The solution of this problem, and the beginning of all really efficient metal sawing, came when MARVEL Engineers gave up the "alchemists' dream" of finding a single metal that would combine the diametrically opposed characteristics needed and started on the development of a *bi-metal* hack saw blade as the only way to combine in one blade both the fastest cutting, longest lasting cutting edge, and great strength and toughness.

Many additional years of research, experiment, development, tests and refinement were required to perfect the MARVEL High-Speed-Edge Hack Saw Blade, and to design and build the special machines, processes and plant to manufacture them. In 1926 MARVEL introduced this composite blade, in which a high speed steel cutting edge was integrally welded to a

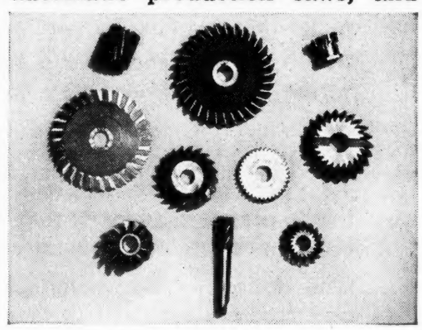


"a marriage of metals"

tough chrome-vanadium alloy steel body. This "marriage of metals" in the MARVEL High-Speed-Edge Hack Saw Blade produced a positively unbreakable blade with the longest-lasting, fastest-cutting edge, and strength to withstand the heaviest feed pressures.

Before the advent of the MARVEL High-Speed-Edge Hack Saw Blade, run-outs (inaccurate cutting) were prevalent too, because the ends would pull out before any blade could be sufficiently tensioned. Blades were of many type names and classes. Blade failures were blamed on "the wrong blade for the job," and the MARVEL statements of "one superior blade for all machinable metals" and "positively unbreakable under any attainable speed or feed," was so unbelievable that it had to be literally proven by demonstration, shop by shop.

The MARVEL High-Speed-Edge Blade, with its tremendously strong body permitted the development of the first truly high speed sawing machines, the all-ball-bearing heavy duty hack saws, the first high speed, automatic production saws, and



"cutting tool, can't be too rigid"

finally, the giant hydraulic hack saws, culminating in the super-giant hydraulic hack saw with 24″ x 24″ capacity. Metal sawing costs dropped proportionately and became an efficient and accurate operation.

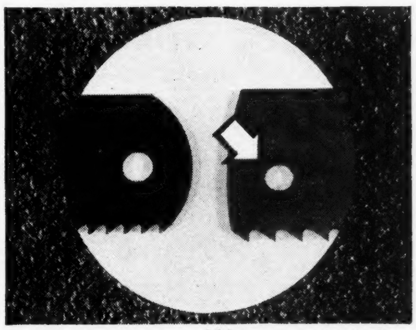
With increased application, a science of metal sawing developed and, as always, when the market is divided between the "haves and the have nots," there has been much contention as to the factors involved in sawing efficiency. Today, there is much argument as to what constitutes "sufficient" blade tension. MARVEL believes that a hack saw blade, like any other cutting tool, cannot be too rigid (tensioned too tight) in its holder or frame; that a loose cutting tool in a hack saw, milling machine, lathe, or other machine tool cuts inaccurately and will chatter. Due to their composite construction, the load-carrying has been raised to the

For more information on products advertised, use Inquiry Card, Page 215

(Advertisement)

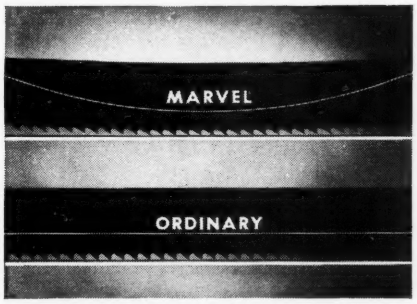
point where MARVEL High-Speed-Edge Hack Saw Blades can be tensioned from 200% to 300% tauter than any one-piece, solid blade can be tensioned without danger of pulling out its ends. MARVEL Blades are *unbreakable* and that statement also definitely covers that common weakness in all one-piece blades. It seems obvious that any limit on tensioning places a related limit on feed pressure, and hence on the output of any machine.

MARVEL Engineering revealed another neglected factor in good metal sawing — the location of the pin holes by which the blade is held in the saw frame. These gripping holes provide the sole means for transferring tension to a saw blade. Standard practice places these holes in the center of the blade ends.

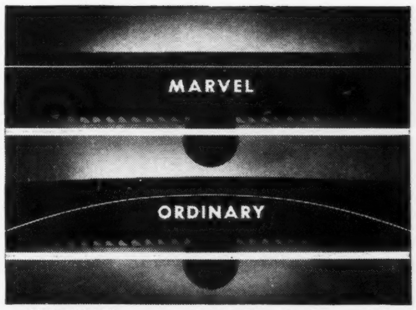


"another difference *** location of holes"

MARVEL engineering established that with centered holes, the equitension along the center line of the blade between the holes and across the entire width of the blade *before* the blade entered the work, was destroyed the instant the blade contacted the work. The combination of horizontal tension and vertical pressure (work resistance) formed a "tension arc" patterned from one pin hole upward to the top of the blade midway between pin holes and down to the other hole. This rainbow-like stress tends to create a nil tension condition at the leading or cutting edge of the blade.



"tension before blade enters work"



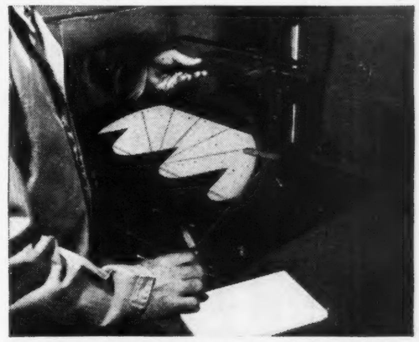
"MARVEL has a straight edge in the work"

In MARVEL High - Speed - Edge Blades, the clamping pin holes are placed well below the vertical center of blade ends—are as close to the cutting edge as is practical. As a result, the 200% to 300% greater working tensions of MARVEL Blades are confined to the lower, working one-third of the blade before it enters the work. Though parallel conditions to those with other blades are set up under identical operations, with the MARVEL Blades work resistance does not wholly overcome tension and the leading edge is taut *at all times*.

Also, with tension holes below center, a MARVEL blade becomes slightly convex when tightened in a saw frame. Blades with centered pin holes are straight, due to equitension across the entire breadth. *But,* when work resistance is encountered, the flex of the blade is naturally greatest in the unsupported center section. Consequently, MARVEL has a straight cutting edge *in the work,* whereas others become concave, overloading the end teeth sections. These features permit higher speeds and heavier feeds with accuracy, because they lessen the tendency of the blade to wander. The pin hole areas of MARVEL High - Speed - Edge Blades are also hardened by an additional process to eliminate elongation and loss of essential tensions.

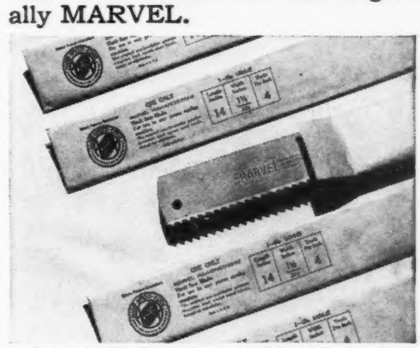
The contour of every tooth in each MARVEL High-Speed-Edge Blade is identical to the nth degree. This is an exclusive feature, made possible only by MARVEL'S highly technical and exclusive method of forming the teeth. The special machines which perform this operation were designed and built by MARVEL engineers in the MARVEL plant and are without duplicates. This absolute uniformity of teeth produces a faster cutting blade with superior chip elimination from the kerf.

Following rigid tests and meticulous inspection of every blade, *each* is individually enveloped for continuous protection until it is ready



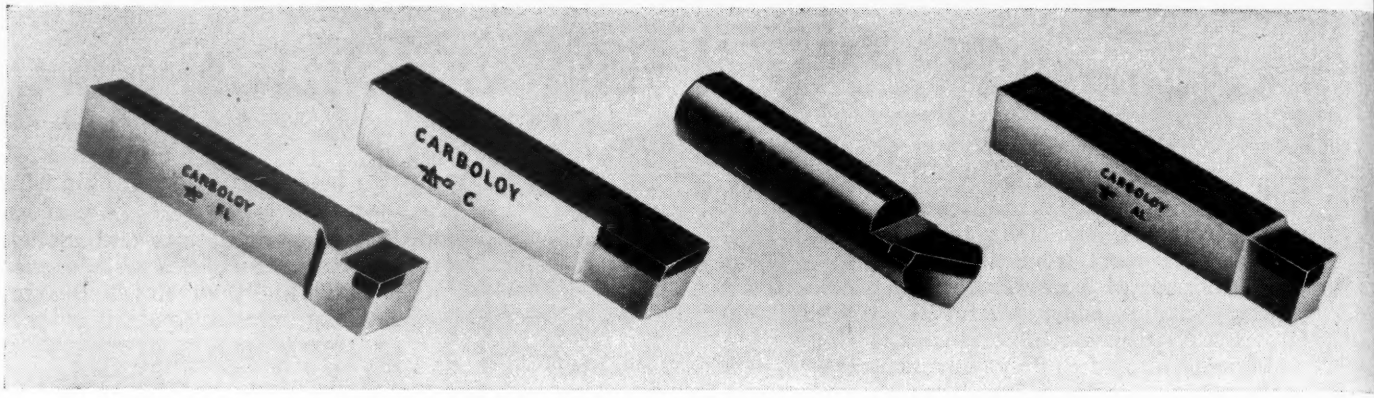
"each tooth identical to the nth degree"

to be put to end use. It is a certainty that all cutting tools should be afforded the utmost care to prevent dulling or set wear before use, and this is borne out by the fact that files, taps, and other similar tools are all individually wrapped, as are MARVEL High-Speed-Edge Hack Saw Blades. After enveloping, ten blades are boxed in the standard package — not dozens — and these two features are also originally MARVEL.



"in individual envelopes — 10 to the box"

Bulletin ST-50 gives complete specifications and price information on all MARVEL High-Speed-Edge Hack Saw Blades as well as MARVEL High-Speed-Edge Hole Saws, the latter incorporating many of the construction details of the blades. Ask for it as the first step in the reduction of cut-off costs. Write Armstrong-Blum Mfg. Co., 5700 Bloomingdale Ave., Chicago 39, Ill., U.S.A.



"Typical of the more than 700 standard Carboloy Tools and Blanks stocked by distributors in 88 cities, coast to coast."

Uniformity is the keynote

. . . and it pays

WHEN YOU SPECIFY Carboloy Cemented Carbides, you can be sure that you'll get uniformity—in every tool, in every order, in every re-grind.

And you can be sure, too, that this uniformity pays off—by helping reduce costs, eliminate waste and increase production in your plant.

You find proof of this pay-off everywhere in industry—in case histories like those on the opposite page, or among manufacturers you personally know who have found standard Carboloy Tools and Blanks to be the answer to their metal cutting problems.

Why not be sure you're getting the most out of *your* carbide operations? Use standard Carboloy Cemented Carbides *today;* realize their benefits tomorrow. Carboloy Company, Inc., 11149 E. 8 Mile Road, Detroit 32, Michigan.

RESULTS are more spectacular when Carboloy Cemented Carbides are used under the unique "Triple C" Plan of Coordinated Carbide Control. Get your copy of the CCC Plan Book, which explains in detail how this program operates.

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